JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

VOL. 24 NOVEMBER 17, 1943 No. 4

CLINTON HART MERRIAM—1855–1942*

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C. Hart Merriam was the first president of the American Society of Mammalogists. In itself, this might not be significant, but to those familiar with the history of American mammalogy it marks the expression of a rarely equalled preeminence of one man in a given field of science. But for him a society of mammalogists might not have been possible and, although younger men were more active in promoting the organization, no other could have been thought of for the honor of presiding at its opening sessions. His position was unique and everyone recognized it. He was the central figure and the most dynamic in an era of very great activity and progress. To review his life is to recapitulate the events of this era and to indicate their far reaching effects not only in this country but throughout the world.

EARLY LIFE

He was born December 5, 1855, at Locust Grove, New York, where his parents lived in a rural mansion surrounded by ample acres and shadowed by the Adirondack Mountains. In such surroundings many a boy has a passion for the woods and fields even to the extent of beginning seriously to probe their secrets. Sometimes it may continue through life, but usually only as a pastime and a refuge from interests that are considered more practical. This boy, however, saw his career in it and from his early teens was engrossed with it. His parents encouraged rather than hindered it and the way opened up for him in a manner which probably even exceeded his boyhood dreams. That he had such dreams no one can doubt, for to the end of his days he continued to plan large undertakings.

His father and mother were of old American stock, Merriam himself directly descended from one of two brothers who came from England to settle in Connecticut prior to 1830. Dewitt Clinton, the distinguished governor of New York in the first decades of the nineteenth century, was a family hero and his name was borne through several generations of Merriams. It was subordinated to an initial in our subject mainly to distinguish him, especially in family circles, from

* For other biographical sketches of the same subject see Talbot and Talbot, Science, **95**, pp. 45–46, 1942; Fisher, Jour. Wash. Acad. Sci., **32**, pp. 318–320, 1942.

his father Clinton L. Merriam. The name Hart was from his mother who was born Caroline Hart. His father was something more than a country gentleman —a man of ability and energy, a leader in his community, and for some time member for his district in the Federal House of Representatives. He had more than ordinary interest in natural history and it is recorded that he was in correspondence with John Muir as early as 1871, the subject being glaciation in Yosemite Valley.

Hart had one older brother, Charles Collins Merriam, who was for a time associated with his father in Washington while he was a Member of Congress. Later he led an active life managing a large farm near Lyons Falls, Lewis Co., New York, and carrying on extensive lumber interests in the Adirondacks. Hart's sister, somewhat younger than himself, now best known as Florence Merriam Bailey, shared her brother's love of nature and never was far from him although following an independent career in which she became a charming writer and a distinguished observer of American birds.

When only fifteen years of age, young Merriam had already begun the formation of a private collection of bird skins and had gone through the patience-trying struggles involved in learning to prepare such specimens. In fact his father had provided him with a single-barreled shotgun when he was only thirteen or fourteen and, later, had taken him to a taxidermist (John Wallace) in New York City for instruction in the mysteries of skinning and mounting birds. This was at the instance of Prof. Baird to whom his father had taken the boy in Washington in 1877. With this foundation and burning with youthful ambition, at the age of seventeen he was attached to a government expedition, the Hayden Survey, through his father's influence, plus that of Prof. Baird, and went west to spend a summer collecting birds and eggs in the Yellowstone region. On this trip he collected 313 bird skins and 67 nests and eggs. Methods of mammal collecting were then unknown to him and apparently he confined his efforts mainly to birds. His report of some fifty pages which appeared in 1873 in the Sixth Annual Report of the U. S. Geological Survey of the Territories is his first contribution to zoological literature, a slightly annotated and largely tabular record of specimens collected. Significant is his acknowledgment of aid received from S. F. Baird and Robert Ridgway, indicating that he was already in touch with leaders in the subject that had fascinated him. Other young men on the survey included John M. Coulter, botanist, Henry Gannett, geologist and astronomer, and W. H. Holmes, artist, all of whom later attained national prominence and became his lifelong friends. At this time, also, he met others, including Henry W. Henshaw whose reminiscences, published in the *Condor* (vol. XXII, p. 4, 1919), refer to him as follows: "It was in 1872 that I first met Dr. Merriam, then a boy of sixteen, just back from his first trip to the Yellowstone region with the Hayden Survey. He had much to tell of the wonders of the region, which then had been seen only by a favored few, and where he had made a valuable collection of birds, which we examined together with mutual interest."

In later life, Merriam frequently referred to this trip and there can be little doubt it was a powerful influence in shaping his career. It gave him a taste of

the great West which he subsequently quartered so thoroughly and it connected him directly with the era of its geographic exploration which was just closing. The Pacific Railroad surveys were not very far back, the men who participated in them were still living, and the spirit of discovery was still rife. Baird, especially, as Secretary of the Smithsonian Institution, had shown the possibilities of promoting zoological knowledge through the cooperation of governmental agencies and it is not unlikely that Baird, directly or indirectly, planted the seed in Merriam's mind that later bore so much fruit.

At seventeen years of age, however, a young man of good family could not be allowed to follow a supposed hobby exclusively. After a preparation at the Pingry Military School in Elizabeth, New Jersey, he was sent in 1874 to Yale, where he spent four years in the Sheffield Scientific School with medicine perforce as an objective, but with his interest in natural history getting stimulation and encouragement from such men in the faculty as A. Hyatt Verrill, Sidney I. Smith and Daniel Cady Eaton. Among his classmates was the biologist E. B. Wilson. While in New Haven, his interest in birds never flagged and before he left there or shortly after, in 1877, he published an account of "The Birds of Connecticut." Thence he went to Columbia to the College of Physicians and Surgeons, receiving his M.D. in 1879, at the age of twenty-four. During these student days he made lifetime friendships and continued to expand his connections with young naturalists of the period. In 1874, as indicated by a brief published paper "Notes from the South," he had an outing in Florida and in 1875 he was temporarily employed by the U. S. Fish Commission. Results of his observations of birds in the vicinity of his home were published in 1878 and 1879 under the title "Some Birds of Lewis County, New York." On March 7, 1878, while still a medical student in New York, he assisted in organizing the Linnaean Society of New York and was elected its first president.

At this time, ornithology was receiving much attention in various quarters and especially in Cambridge, Massachusetts, where a coterie of young men were actively engaged in forming private collections of bird skins. These included William Brewster, Henry Henshaw, Ruthven Deane, and Charles Batchelder. This group in 1871 organized the Nuttall Ornithological Club and Merriam was one of the early contributors to its "Bulletin" which began in 1876.

From 1879 to 1885 he followed the practice of medicine in Locust Grove, apparently with marked success, but the record shows that during this time he was also very active in studying the local fauna, in building up his collections, in correspondence and personal contact with others of similar taste, and in developing a growing interest in mammals as well as birds. In the spring of 1883 he went to Newfoundland and the Gulf of St. Lawrence as surgeon of the S.S. Proteus engaged in a sealing expedition which gave him the opportunity to observe the great migration of seals and to collect many specimens. The series of skulls obtained on this trip, especially of the hooded seal, is still the finest in existence.

In 1881 he published a "Preliminary List of the Birds of the Adirondacks" but, thereafter, although active in promoting ornithological work, his personal effort

was devoted almost entirely to mammals. This effort began at home and the energy, patience, and thoroughness he gave to it was evidenced by the appearance, in 1884 of his "Mammals of the Adirondacks," a large comprehensive book almost exhaustive in character and setting a new standard for local studies. For its time, it was quite unusual, comparable in some respects to certain studies of birds, but surpassing anything of the kind relating to mammals. It gave little attention to description and classification, these at the time being taken for granted or regarded as closed subjects. It was rather a series of "life histories" giving every shred of information obtained through his own observations since boyhood and everything trustworthy he had been able to derive from others. It was a remarkable piece of work for one scarcely more than a beginner and it is still a valuable source of information not yet superseded. After issuance in parts in the Transactions of the Linnaean Society of New York, it appeared as a handsomely bound volume of small quarto size and dignified character. Possibly it was subsidized by his father whose interest was somewhat more than paternal. It is significant that it was an ambitious undertaking, planned on a comprehensive scale, and the forerunner of much that came later.

It is probable that the "Mammals of the Adrondacks" was only a part of a much larger plan, which even at this early date he had conceived. He had the works of DeKay on New York State and he had read Humboldt and Wallace and become greatly interested in the underlying problems of the geographic distribution of animals. He began to consider the idea of a general biological survey of New York State and went so far as to employ a clerk to search meteorological records and especially to compute mean temperatures for each month in the year. He obtained introductions to James Hall, C. D. Walcott, and others and interviewed them in Albany with the object of securing their aid in obtaining an appropriation for the proposed survey from the state legislature. Failing in this, he settled to the practice of medicine and went on with his study of the mammals. Among various foreshadowings of his future which appeared when he was scarcely more than a youth, this is perhaps the most significant.

AMERICAN ORNITHOLOGISTS UNION

In 1883, such a great interest in ornithology had developed throughout the country and so many distinguished ornithologists were located outside New England that the Nuttall Club was submerged in the formation of a larger, more truly national organization, The American Ornithologists Union, modeled somewhat on the British Ornithologists Union but inspired by the fellowship of a remarkable set of men. Its founders, who held their first meeting in New York Sept. 26, 1883, formed a varied group, the like of which can never again be brought together. Their names, with few exceptions, are now on the honor roll of achievement in a subject that has numbered its followers by thousands with many fascinating ramifications extending to every state in the Union and beyond our borders to a great part of the world. Looking back at these men now, one finds it difficult to avoid the feeling that they measured to an average stature beyond that of any later period. Whether they were the products of their times

or vice versa, at least it must be said that they and their opportunities were well met. The seniors in this group were such as Spencer F. Baird, George N. Lawrence, Charles E. Bendire, Elliot Coues, J. A. Allen, and Robert Ridgway. Merriam was one of the younger members and must have been greatly influenced by his associations. Nevertheless, he immediately made himself felt. He was elected secretary of the new organization and became Chairman of its important Committee on Bird Migration, a subject on which preliminary work had been started by Prof. W. W. Cooke. The large-scale collection of factual data was almost a passion with him and this committee offered his first chance to exercise it in a broad way. He made elaborate plans (see the Auk, vol. 1, pp. 71–76, Jan. 1884), dividing the country into thirteen districts, each having a superintendent, and undertook correspondence with all of them and the collation of their data. It was a nationwide project which just suited him and which doubtless was suggestive of possibilities in other directions.

GROWING INTEREST IN MAMMALS

Meanwhile, notwithstanding the impetus given to ornithology by the organization of the A.O.U., Merriam's interest in mammals continued to grow and his private collection of them was enlarged to proportions which at that time were unprecedented. Private collections of birds were numerous, some of them even rivalling those of public institutions, but similar collections of mammals were practically non-existent. The readily obtainable mammals of any given locality were few in number and there was no general interest in them. Bird collectors and local taxidermists sometimes preserved them but in small numbers and mostly including only diurnal species, such as squirrels and rabbits which fell to their guns while afield with other objects. It was from such sources that many of his specimens came and he carried on a large correspondence, promoting interest in mammals by purchasing specimens and, in some cases, by employing collectors or at least by placing standing orders. Among those with whom he was in touch, about 1883, was a farmer's boy of Elk River, Minnesota, Vernon Bailey by name. This boy's specimens were so well prepared and included so many species thought to be difficult to obtain that Merriam gave him exceptional encouragement. It is related that he once asked Bailey for specimens of shrews, tiny mammals of nocturnal and secretive habits then supposed to be rare. Bailey replied, saying "How many do you want?" At that time specimens of shrews derived mainly from something the cat brought in, something that fell in the well, or something found dead and decayed in the road, so Merriam then wrote Bailey "all you can get." Some time later, Bailey sent him no fewer than sixty shrews and it is not unlikely that then and there he envisioned the possibilities of a continental campaign of mammal collecting. Until then his formation of a mammal collection had been a dubious venture which probably would have failed if undertaken ten years earlier. The time was exactly right for it not only because he had found a successful collector but because there had just been devised a small trap adapted for use in field and forest as well as on the pantry shelf. This trap, called the Cyclone, was an affair of tin and wire springs, only

about two inches square when collapsed, cheap in cost, and easily portable in quantity. Also high standards had just been reached in the preparation of mammal skins and skulls following the example set by the ornithologists who had carried the art of making study skins of birds to a high degree of perfection.

In the beginning, it is possible that Merriam's interest in mammals had been due partly to general interest in zoology and partly to a certain perversity or contrariness which followed him through life. Most of his contemporary associates were ornithologists only, with a large following of amateurs and a subject of established method and great popularity. It was not in his nature to follow the herd, however, and although birds were his earliest interest, never wholly relinquished, he probably began the special study of mammals before he fully realized its possibilities. Whether or not he was favored with something akin to the Midas touch, it is certain that he rose to every occasion with energy, determination, and a personal magnetism which carried him to success.

In the early eighties what was known of American mammals, to say nothing of the rest of the world, was pitifully little. Small and, from present standards, very scrappy collections were in the American Museum at New York and the National Museum at Washington. The specimens were poorly prepared, imperfect, and often lacking in data. One or two of a kind was the rule and the number of kinds was scarcely greater than had been known to Audubon and Bachman thirty years before. Mammalogists, as such, were practically unknown and the few studies that had been made were those of men who were primarily ornithologists, notably S. F. Baird, Elliot Coues, and J. A. Allen. The subject was not only neglected; it was thought to be unproductive and sufficiently canvassed. The larger mammals were supposed to be of uniform character throughout the country and, with a few exceptions, the existence of the smaller ones was scarcely even suspected.

Into this situation then came the combination of Merriam, Bailey, and the Cyclone trap, and of these no one will ever deny that Merriam was the greatest. He immediately gave Bailey further commissions and as soon as he was able kept him in the field almost continuously. In 1884 he described his first new species, *Atophyrax bendirii*, a small shrew obtained for him in Oregon by the ornithologist Captain Charles E. Bendire. His collection of mammals had then reached a total of some seven thousand specimens and for working purposes was probably superior to any public collection.

FOUNDING AND GROWTH OF BIOLOGICAL SURVEY

At this time, however, although carrying on the medical practice in Locust Grove, he was occupied with his plans for a broad study of bird migration through the committee of the Ornithologists' Union of which he was Chairman. This work had grown to such proportions it was evident the A.O.U. could not carry it without help and the enlistment of the aid of the Federal government was considered with the result that in the spring of 1885 Congress authorized the establishment of a section of ornithology in the Division of Entomology, then a branch of the office of the "Commissioner" of Agriculture. The A.O.U. was

consulted in the choice of a man to take charge of the work and through Professor Baird, whose influence doubtless weighed heavily in the whole matter, Merriam was invited to take the position with the title of Ornithologist. At the time, Merriam was in Europe where he had gone for a respite from medical practice which had become rather onerous. He had visited various naturalists, notably Blasius of Braunschweig and Graf von Berlepsch of Berlin, Germany, and after cabling his acceptance of the offer he returned in time to take up the duties of the new office July 1, 1885. Meanwhile, for Assistant Ornithologist, he had invited Dr. Albert K. Fisher with whom he had developed a warm friendship while they were fellow students at the College of Physicians and Surgeons in New York—a friendship which lasted for more than sixty years. With one clerk, Merriam and Fisher, neither of whom had yet seen their thirtieth birthdays, then started what has since become a bureau with hundreds of employees and millions of dollars in appropriations. Within a year, they obtained independent rank as the Division of Ornithology and in 1888 this was expanded to Division of Economic Ornithology and Mammalogy, a title which in later years was sometimes jestingly and perhaps a little maliciously changed colloquially to "Economic Ornithology and *Extravagant* Mammalogy." Later, the simpler title Division of Ornithology and Mammalogy was used. In the beginning, growth was not very rapid, but in the late nineties there was considerable expansion and on March 3, 1905, the title was again changed to Bureau of Biological Survey. Very recently (1940) and long after Merriam's retirement, the work was transferred to the Department of the Interior where it was joined with the former Fish Commission and the two now go on as the Fish and Wild Life Service.

A critical period for the young organization was passed in its first year when it succeeded in divorcing itself from the entomologists. This was done against the opposition of Dr. C. V. Riley, then head of the Division of Entomology. Merriam's father at this time was retired from Congress, but he still had many influential friends, among them, especially, Senator Warner Miller, then Chairman of the Senate Committee on Agriculture. Fisher also had a friend in Representative Stuhlracker and by combined efforts, perhaps with the assistance of Baird and G. Brown Goode, who were very friendly to Merriam, Congress was induced to establish the independent division with a total appropriation of $10,000 (raised from $5,000 received the first year) as of July 1, 1886.

After this, it was plain sailing, at least for a number of years. As the Chief of a growing scientific bureau in Washington, Merriam soon became a national figure and for twenty-five years of his activity in this post his career was crowded with interest and accomplishment. During the first few years, work was mainly in the completion of projects previously outlined and perhaps designed to justify their federal support, since their bearing on agriculture and public welfare was obvious. Early additions to the staff were Walter B. Barrows, W. W. Cooke, and F. E. L. Beal, all of them so-called "economic" ornithologists. Very shortly (1888 and 1889) two exhaustive "Bulletins" were published, "Bird Migration in the Mississippi Valley" by Cooke and "The English Sparrow in America" by Barrows, the first especially being replete with evidences of Merriam's careful

editing and supervision. Somewhat later (1892) came Fisher's "Hawks and Owls of the United States in their Relation to Agriculture," a thorough study, handsomely illustrated, which was received with much acclaim and which is now a classic. These three excellent bulletins were widely circulated and established public esteem for the work of Merriam's division, doubtless contributing to its continued support and growth.

EXPLORATION AND RESEARCH

Meanwhile, Merriam had other and longer range plans, especially for himself. Vernon Bailey had been employed as field agent and was ranging the West, sending in previously unknown species of mammals with every shipment, and the study and description of these received Merriam's enthusiastic attention. He obtained the authority for inauguration of a technical series of publications by the Department of Agriculture under the title "North American Fauna" and in the first number an announcement stated that "The Division of Ornithology and Mammalogy is engaged in mapping the geographical distribution of birds and mammals, *in addition* to a study of their economic relations. The purpose of this work is to ascertain the boundaries of the natural faunal areas of North America." Thus at an early date (1889) his broad plan was clearly envisioned and his future career outlined.

In the first four numbers of the North American Fauna and within two years (1889 and 1890) he described no fewer than seventy-one new species as well as several new genera of mammals. To zoologists throughout the country this was startling, unprecedented, and to some who doubted his standards it even seemed preposterous. It was soon evident, however, that he was not splitting hairs unduly, but was announcing real discoveries. Others began to adopt his methods not only in America but abroad and an era of discovery in mammalian classification was started which even now has not fully run its course and which has provided a basis for innumerable studies and interpretations ramifying in many directions.

As soon as practical, he arranged for a personal expedition to the West going with Vernon Bailey to the San Francisco Mountain region of Arizona and studying the distribution, not only of mammals, but also of birds, reptiles, and plants. The results of this expedition, published in August 1890, outlined much that was later built upon to establish his reputation as an authority on the subject of the geographic distribution of animals and plants. There was much discussion of life zones, of the origin of faunas, the causes determining distribution, and besides maps of the special area there was a large colored map of North America showing the principal life areas as he conceived them. In subsequent years he wrote and published various papers on distribution, and revised his maps from time to time, but all his fundamental ideas appear in this early report.

Thenceforward he became passionately interested in pursuing his studies of mammals and in carrying the distributional work to the whole of North America. He gathered around him a circle of naturalists and collectors and posted them out from season to season in all directions. In 1891, he organized a larger expedition,

the Death Valley Expedition, which explored the mountains and deserts of southeastern California and Nevada with very large results. This was placed in charge of Dr. T. S. Palmer, since Merriam himself, after starting with the party, was invited by President Harrison to act as a Bering Sea Commissioner to study the fur seals and spent the summer on the Pribilof Islands in Alaska. While work was going on in various parts of the United States, he also sent parties to Canada and to Mexico where E. W. Nelson and E. A. Goldman worked continuously for a number of years. Eyebrows in some quarters lifted at this spending of Federal funds in foreign countries but he justified it as part of a continental job basic to everything else. Although really a man very sensitive to criticism, he usually acted without regard to it, following his bent in spite of it.

From the beginning he made large plans for the study of mammals from all points of view. Not only classification and distribution, but anatomy, ecology, nomenclature, bibliography, and specialized regional studies were among them. Added to these were botanical and general zoological subjects. At first it seemed he was personally ambitious to conduct a whole legion of projects himself and in fact he made preliminary studies in nearly all of them, frequently accumulating considerable data which would be laid away to take up something new. His subordinates who came to him with a bright idea usually found themselves anticipated and if rebuffed there was sometimes feeling. In such cases, those who knew him best were able to see that he was not acting from pure selfishness but because of a perfectionist complex which made him honestly feel that he not only had prior rights but that he could trust no one else to carry out the study in all the detail he had had in mind. The enormous collection of mammals that accumulated under his direction was deposited in the National Museum but with the strict agreement that no one should have access to it except by his order. With minor exceptions, the first ten numbers of the North American Fauna were written by himself and it was inevitable that sly references to him as a czar or a dog in the manger should now and then be heard. In the late nineties, however, he evidently began to revise his all-embracing ambitions and thenceforward many projects were assigned to his staff or to others competent to carry them out. Once this was begun, he freely gave advice and assistance, spending many hours revising the manuscripts of younger men or carefully reviewing their material with them and discussing their conclusions. His standards were high and his methods were worked out with the utmost care. In effect, he founded a school and the output of "Merriam and Merriam's men" was generally admired and respected. From time to time young men of his staff were drawn to institutional positions in various parts of the country where his influence was continued. In certain centers, notably in California, his methods were applied to restricted areas with outstanding results and even in Europe, especially in the British Museum, he was something of an inspiration.

POLITICAL DIFFICULTIES

While he was so actively promoting the study of mammals and what was called life zone work, especially in the West, other lines of activity in the Biologi-

cal Survey were not being neglected, but they were left to subordinates. Food habits research went on effectively under such men as F. E. L. Beal, A. K. Fisher, S. D. Judd, and W. L. McAtee. Game preservation and conservation work began to be important in the late nineties and these were cared for largely by T. S. Palmer, who for many years was Merriam's principal administrative assistant. Although having some of the characteristics of a promoter and a reformer, Merriam was not very worldly and not very diplomatic. As a bureau chief it was his duty each year to go before congressional committees and defend his estimates for appropriations. This was very distasteful to him and whenever possible he sent one of his assistants. Such committees are notoriously overbearing and as Merriam was too independent to submit to grilling, he sometimes gave them rather sharp answers. Although his own career had a political foundation, he himself was not politically minded. His attitude toward certain types of short-sighted congressmen was so transparent that their resentment was unnecessarily engendered and eventually (1908) the agricultural appropriation bill was reported out of committee with the section usually devoted to the Biological Survey entirely omitted. Merriam was dumfounded and at his wit's end. Rumors at once started to the effect that it was because of his disproportionate interest in research rather than directly practical work, but the real reason was probably involved in the personal antipathies of certain congressmen. By his own efforts it is doubtful if he could have extricated himself from the dilemma, which struck not only himself but his whole staff; others, however, had been forehanded in martialling popular pressure against such an emergency and before the bill came to a vote the missing items were reinstated. Not long after this Merriam sent for his old friend Henry W. Henshaw, who was then in Hawaii, and brought him into the Biological Survey as Administrative Assistant with the rather obvious function of appeasing criticism.

BREADTH OF INTERESTS

During his most active years, Merriam was interested in many things besides mammals and the Biological Survey. New and improved methods of doing things fascinated him and every forward looking movement in scientific circles had his active cooperation. He was a member and one time president of the Biological Society and of the Anthropological Society. He was also a member of the Philosophical Society and the National Geographic, serving on the Board of Directors of the latter for many years. He was Chairman of the U. S. Board on Geographic Names for nine years (1917–1925) seldom missing a meeting. He was active in founding the Washington Academy of Sciences and was especially devoted to the launching of its publications. He was also one of those consulted in laying the original plans for the Carnegie Institution. On April 17, 1902, he was elected a member of the National Academy of Sciences and when its meetings were held in Washington several of its members were always billeted in his home. In 1899, he organized and directed the Harriman Alaska Expedition, a unique affair in which he took great delight. When Mr. Harriman, who had been advised that Merriam was the man to carry out his plan, called on him

in his small office and announced his desire to take a vacation with his family and fifteen or twenty of the leading naturalists of the country, Merriam had never heard of him and at first thought he was being hoaxed. He was soon convinced, however, and agreed to select the galaxy which finally made up the party. On the return, he undertook the editing and publishing of the handsome series of volumes reporting on the many-sided observations of the Alaskan cruise. This work he did at home in his spare time, not only editing the manuscripts but giving meticulous care to every detail of typography, paper, format, and illustration.

Throughout his life he was given to enthusiasms which were not exactly hobbies, for they were usually constructive, but since he did everything with his might, they often led him away from his main course. Through his practice in supervising the publications of the Biological Survey he began to investigate the qualities of printing papers. Instead of accepting some authority, he undertook an exhaustive study of the entire problem, familiarizing himself with every detail and finally joining with H. W. Wiley, then chemist of the Department of Agriculture, in publishing an authoritative bulletin covering the subject. For several months, paper was constantly uppermost in his mind and for long after he seldom lost an opportunity to discourse on it.

For many years he spent most of his summers in the West traveling with wagon or pack train, returning to Washington for the winter. When the automobile began to be generally used, it suddenly struck his fancy and he developed a strange enthusiasm for everything pertaining to motor cars. He made several transcontinental trips with his family at a time when roads and cars were far from perfect; he haunted salesrooms and repair shops and his house desk was filled with catalogues and circulars. He knew every make of car from its emblem to its horse power and he carefully weighed the relative merits of every detail. His own car he was convinced was the best and he was always ready with arguments to prove it. To his intimates, who knew he had neither training nor natural capacity for engineering and mechanics, this was little less than amusing, but they could also see in it an expression of his very unusual character. He cared little for current affairs, music, art, or general literature. He openly scorned orthodox religion and society in the usual sense he regarded as pure waste of time. But wherever his interest was really roused his whole power went into it with a tremendous urge to get at the facts and to take no one's word for them.

INTEREST IN CALIFORNIA

His field work in the West gradually concentrated on the great state of California not only because it offered many interesting problems but because more than anywhere else his passionate love for forests and mountains was gratified. He explored every nook and corner of it and finally built himself a home in the depths of the redwoods of Marin County near the village of Lagunitas. Everything pertaining to California then received his attention. He associated himself with the Sierra Club and his friendships extended to such as Carlos Hittell, the historian, and William Keith, the artist, as well as John Muir, the literary natu-

ralist. His eschewal of general culture, therefore, did not extend to its creative personalities. During his travels in California he had many contacts with the numerous dwindling tribes of Indians in the state. Many of these were represented by only a single family or in some cases by a single aged individual. Their pitiful economic condition excited his warm sympathy and he often befriended them. Inevitably his interest took the constructive turn when he realized that they possessed many interesting secrets which would die with them unless salvaged at once. Thereafter they became almost if not quite the leading interest of his life. At a fairly early date he had collected various examples of Indian handiwork, especially basketry, and eventually his collection of Indian baskets became a large and valuable one. It was kept in the spacious study of his home where it gradually dominated all ordinary furnishings from floor to ceiling and where individual pieces at gatherings of his friends often furnished the text for choice anecdotes or long fascinating folk tales which he never tired of repeating.

FRIENDSHIPS

Aside from his achievements as a naturalist, Merriam was distinctly a personality. Few who knew him failed to realize that he was something beyond the ordinary. He swept people along with his own enthusiasms to such effect that only carping or jealous critics thought of him as egocentric. He was in fact very warm-hearted, very generous and very sympathetic, but without his respect these qualities were not too greatly exercised. He was not very tolerant of sloth, incompetence, or insubordination, but where these did not exist he was warmth itself. In the Biological Survey he occupied a pedestal, but he did not pose, for he detested insincerity. There was a certain indefinable magnetism about him which caused men of his own or even greater stature to be drawn to him quickly. His friendships among the great and near great were remarkable. Washington in the nineties and for some years after was a delightful place. A charming social cohesion existed among the personnel of the various scientific bureaus and the national cultural institutions. The relations were simple and unconventional but full of warmth and affection. Merriam readily became a part of this and his enthusiasm for his friends was scarcely less than for some of his projects. Outside of Washington his personal relations extended to every important naturalist of his generation. Among those with whom he was especially intimate in Washington were the geographers Henry Gannett and Marcus Baker, the geologist Grove K. Gilbert, the botanist Frederick V. Coville, and the zoologists William H. Dall and Frederick A. Lucas. All these, it should be noted, were men of simple tastes and distinguished accomplishment in their respective fields. His admiration of and affection for G. K. Gilbert was especially significant, for in all the large circle of scientists in Washington at that time no man was more respected for both character and accomplishment than Gilbert. When Gilbert lost his wife, he accepted Merriam's invitation to occupy rooms in his house and literally to become a member of his family, an arrangement which was happily carried out for nineteen years until Gilbert's death in 1918. Merriam's tribute to him published shortly after (Sierra Club Bull., vol. 10, no. 4, 1919) is some-

what revealing as to his own character since he emphasized his admiration for some of those qualities in the even-tempered and ever rational Gilbert which he obviously lacked himself.

A lifelong friendship between Merriam and Theodore Roosevelt led to numerous contacts and interesting incidents. As a youth in New York, Roosevelt had greatly admired Merriam's book on "Mammals of the Adirondacks" and the two were soon brought together. At that time, Roosevelt had serious thoughts of a career as a naturalist and, although he soon gave them up, his interest was a very real one which always remained near to his heart. When he first came to Washington as Assistant Secretary of the Navy he soon sought out Merriam and later when he became President the relations were continued. At one time the Biological Society of Washington was thrilled by the announcement of a program devoted to a sort of debate between Roosevelt and Merriam. At the appointed hour the President bustled across the square from the White House to the Cosmos Club where the meeting was held with a record attendance. Merriam read a carefully prepared argument detailing results of his studies of variation in coyotes and wolves of the western United States and was followed by Roosevelt who spoke without notes at such length and with such an obvious grasp of the subject that many of his hearers were quite amazed. At another time Merriam was invited to spend an evening at the White House and to bring with him all the local naturalists and their families to meet the British nature photographer Cherry Kearton who showed a film of wild birds and other animals which for its time was unusual. When Roosevelt organized his famous African trip, after leaving the presidency, Merriam was one of his principal advisers and was responsible for the choice of a considerable proportion of the personnel of the expedition.

ENDOWMENT FOR RESEARCH

In 1910, fortune again favored Merriam and, with little or no effort on his own part, he was relieved of a situation under which he was obviously growing uneasy. The Biological Survey was gradually becoming more and more an administrative and regulatory bureau with political angles for which he had no taste. Many of the projects which had fascinated him in early life had grown to such proportions that it was plain he could not control them. What he would have done if events had not conspired for him is conjectural, but it is safe to say he would not have been deflected from his personal desires for long. Not improbably he would have retired voluntarily, since he had a small private income and doubtless could have found means to increase it. However, at this time, certain of his friends and admirers thought to have him personally endowed for research with the hope and expectation that he would produce a great work on the mammals of North America. Among those promoting the idea were his very dynamic admirer the hunter-naturalist Charles Sheldon and very probably his still more influential friend Theodore Roosevelt. Mrs. E. H. Harriman, then widowed, was approached with the result that there was established the Harriman Trust to be administered by the Smithsonian Institution and to provide Merriam support

for research of his own choosing to the end of his days. The terms were extraordinarily liberal, practically everything being left to his own decision. Unfortunately it had not been realized that the subject of this wonderful endowment had a tendency to go against the tide, in fact had almost never been known to do exactly what others expected of him. Moreover, his recently developed interest in ethnology was greater than supposed.

At the age of fifty-five, he found himself with a freedom of action beyond most men's dreams, but although he plunged into work with much fervor, it soon became evident that he had changed horses and instead of advancing toward the farther shore he was being carried downstream. He devoted himself almost entirely to field studies among the vanishing tribes of California Indians and to the accumulation of enormously detailed notes about them. This became a passion with him and there can be no doubt he sincerely believed it to be more important than anything else he could do. He particularly felt that he could apply the methods he had used in zoology to better results than those usually attained by ethnologists.

With one notable exception, however, mammals were neglected. This was his study of the American brown and grizzly bears, begun many years before, and only completed when he had amassed specimens (mainly skulls) to the amazing total of 1,864. His division of these into an incredible number of species and subspecies, although received with considerable skepticism, was known to be based on exceedingly careful and reliable studies and his reputation for accuracy of observation was such that no one made any serious attempt to gainsay him. What he had done, however, was to martial his facts and label them without any effort to interpret them. This was characteristic, for he had never been given to theory. His attitude toward controversial subjects connected with the processes of evolution was usually that of suspended judgement with the conviction in most cases that the facts were not all in. When the mutation theory of De Vries was first expounded he promptly took issue with it on the grounds that it failed to explain more than a very small part of the end results of natural evolution as he knew them. Its significance for the future and its other implications did not interest him since they were not in his field and since his own work seemed to him sufficiently engrossing and important. He never wholly relinquished a Lamarckian point of view, for his intimate knowledge of the details of adaptation and evolutionary change would not permit him to accept any experimental evidence which did not fully account for them. Most theories seemed to him premature and he did not indulge in them.

LATER LIFE

His later years were spent in following his enthusiasm for California Indians. He maintained a home in Washington and another at Lagunitas, California, scarcely a year passing that did not see him making a westward transcontinental trip and another eastward. His constant companion was his wife, who was Miss Elizabeth Gosnell, of Martinsburg, West Virginia, whom he had married in 1886. Their younger daughter, now Mrs. M. W. Talbot of Berkeley, California, for

some years before her marriage was also included. An elder daughter, Mrs. Henry Abbott of Washington, remained at home, but family ties were strong and in his declining years grew stronger.

After his wife's death and after he had reached the age of 80, he remained in California most of the time and it may be assumed that his research was not very active. His death in his 87th year on March 19, 1942, followed several years in a nursing home in Berkeley, California, where he was near his daughter Mrs. Talbot and where he was able to walk in the sun, to receive visits from old friends and to have the care which his age and its infirmities demanded.

CONCLUSIONS

The writer of this sketch for some years stood in a relation to Merriam which was too much that of an apprentice or a valet to give him wholly heroic proportions or to fail to appreciate the warmer side of his nature. He was a most extraordinary character, dynamic, productive, and original; but he was full of contradictions. Despite his record of accomplishment and notwithstanding a certain hard-headedness, he was often impractical. When concentrated on a piece of detailed research, no one could have been more insistent on considering every shred of evidence, but in the larger affairs of his life, emotions and enthusiasms swayed him. Among those who were associated with him in subordinate positions in the Biological Survey there were some who fairly worshiped him, and in general the organization was a happy family, but there were also those who could never understand him and who never ceased to be resentful of fancied or in some cases real injustices. On the other hand, his personal charm and originality, his whimsicality, and his forthrightness contributed much to his success. He could hardly be called well balanced, but his inconsistencies were to him at least always connected with the prodigious urge for the advancement of knowledge which never left him. It cannot be denied that the conduct of his later years under the Harriman Trust was a disappointment to his friends, especially among mammalogists. Nevertheless there is little doubt that his intentions were of the best. An impression prevailed that he greatly magnified the importance of his ethnological studies and that he laid out a program for himself involving such detail that it was not humanly possible to finish it in his lifetime. He published a few papers in ethnological journals and two books of folk tales, but the bulk of his results were left in a tremendous mass of notes and manuscripts now deposited with the Smithsonian Institution.

His genius was of the kind that has the capacity for taking infinite pains. In his early work he was quick to see that his subject was shot with false conclusions due primarily to insufficient or faulty material. It became his passion, therefore, to put it on a sound basis, to correct the errors of his predecessors, and to lay a foundation for all time. He did this and much more. Perhaps his greatest contribution to his time lay in his perfecting of methods, in the use of large series of specimens, in the persistent emphasis upon exactness of geographic data, in the demonstration of a previously unsuspected importance of cranial characters in the finer divisions of mammalian classification, and in his steadfast belief in the

combination of field and laboratory studies. His own concrete production was very large and space does not permit its enumeration. His published writings include well over 600 titles. New mammals discovered and described by him number approximately 660. The types of 651 of these are in the U. S. National Museum; 8 are in other American museums, and one in the British Museum. The collection of mammals which he started in his first years of government service was reported in 1940 to contain 136,613 specimens, vastly more than any other collection, and all with full data and in prime condition. Contemporary opinion usually thought of him as most engrossed with studies of life-zones, laws of temperature control, and the general subject of geographic distribution, but his own secret pride was in his "Monographic Revision of the Pocket Gophers", a most exhaustive study which revealed him as a perfectionist. At the time it was published (1895), there is no doubt his intense desire was to go on with similar studies of other groups.

In the history of American mammalogy his place is a very large one, in fact it can scarcely be judged as less than preeminent. What he did is scarcely less important than what he influenced others to do. He was a power in the land with a reach into posterity that will long be felt. His contemporaries familiar with his whole career are now few in number and need no reminder that his was a remarkably complicated personality. For others, his record stands, but it cannot reveal the nuances of his unique character nor the warmth of his personal relations.

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BIBLIOGRAPHY OF CLINTON HART MERRIAM

By Hilda W. Grinnell

In the following bibliography each title has been taken from the original publication, unless otherwise stated. "[C. H. M.]" after a title indicates that, although anonymous as printed, it appears over C. Hart Merriam's signature in his personal scrapbook.

Newspaper articles and all mimeographed materials are here excluded. A search through the Index Medicus has revealed but one title by Merriam (see year 1880). One of his two daughters, Mrs. M. W. Talbot of Berkeley, has told the writer that the notes on certain phases of her father's medical experiences were arranged by him for publication in book form, but that on its way to the printer the manuscript was lost in the mail and no duplicate copy had been kept.

Assistance in finding elusive titles has generously been given by Mrs. Talbot, her sister, Mrs. H. D. Abbot, of Washington, D. C., and by Miss Isabel H. Jackson of the United States Documents Division of the University of California Library.

To Dr. Alden H. Miller, Director of the Museum of Vertebrate Zoology, the writer is indebted for certain facilities, and to Dr. E. Raymond Hall and Mr. Donald F. Hoffmeister for much helpful criticism.

Since the writer is continuing her search for titles by C. Hart Merriam she will be grateful to any readers who may supply her with titles overlooked in the list of 490 here appended.

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2. The olive-sided flycatcher. Amer. Nat., vol. 8, no. 5, p. 309.
3. The chimney swift; change in place of nesting. Amer. Nat., vol. 8, no. 5, pp. 367–368.

1876

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1877

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3. Recent lists of the birds of central New York. Bull. Nutt. Ornith. Club, vol. 3, no. 2, pp. 83–86.
4. Early Arrivals. Familiar Science and Fanciers' Journal, vol. 5, p. 72 [not seen by me].
5. Correction. The County, vol. 2, p. 25 [not seen by me].
6. Breeding of the pine linnet in northern New York. Forest and Stream, vol. 10, no. 24, p. 463.
7. Remarks on some of the birds of Lewis County, northern New York. (Continued from p. 56.) Bull. Nutt. Ornith. Club, vol. 3, no. 3, pp. 123–128.
8. Nesting of the banded three-toed woodpecker (*Picoides americanus*) in northern New York. Bull. Nutt. Ornith. Club, vol. 3, no. 4, p. 200.
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10. Milk-snake swallowing a striped-snake. Science News (N. Y.) p. 64 [not seen by me].

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2. The birds of New York. Forest and Stream, vol. 12, no. 15, p. 285.
3. [Review of] A revised list of the birds of central New York. Bull. Nutt. Ornith. Club, vol. 4, no. 3, pp. 172–175.

1880

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2. Fee bill of the Lewis County medical society . . . , [C. H. Merriam and J. H. Crosby] [Pamphlet] pp. 1–8.

1881

1. Tree-climbing woodchucks. Forest and Stream, vol. 16, no. 23, p. 453.
2. Skunks and hydrophobia. Forest and Stream, vol. 16, no. 24, p. 473.
3. Preliminary list of birds ascertained to occur in the Adirondack region, northeastern New York. Bull. Nutt. Ornith. Club, vol. 6, no. 4, pp. 225–235.
4. Xanthocephalus icterocephalus in lower Canada. Bull. Nutt. Ornith. Club, vol. 6, no. 4, p. 246.
5. Breeding of Barrow's Golden-eye in lower Canada. Bull. Nutt. Ornith. Club, vol. 6, no. 4, p. 249.
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7. Beechnuts and woodpeckers. Forest and Stream, vol. 17, no. 18, p. 347.

1882

1. Another gannet (*Sula bassana*) from the interior of New York State. Ornith. and Ool., vol. 6, no. 12, p. 96.
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11. Early arrival of the Pine Grosbeak in northern New York. Forest and Stream, vol. 19, p. 306.
12. The vertebrates of the Adirondack region, northeastern New York. Trans. Linn. Soc. N. Y., vol. 1, pp. 1–106 [Continued in vol. 2, pp. 1–214, Aug., 1884].

1883

1. Last moose in the Adirondacks. Forest and Stream, vol. 19, no. 23, p. 447.
2. Ravages of a rare scolytid beetle in the sugar maples of northeastern New York. Amer. Nat., vol. 17, no. 1, pp. 84–86, 5 figs. in text.
3. Illegal fishing in Lake Champlain—A hint to the Vermont fish commissioners. Forest and Stream, vol. 20, no. 4, pp. 71–72.
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21. Odd nesting habits of the blue yellow-backed warbler in Missouri. Auk, vol. 2, no. 4, p. 377.
22. Swainson's warbler in Jamaica. Auk, vol. 2, no. 4, p. 377.
23. An albino surf duck (*Œdemia perspicillata*). Auk, vol. 2, no. 4, p. 386.
24. Vogelwanderung in Amerika. *In* Bericht über das permanente internationale ornithologische Comite und ähnliche Einrichtungen in einzelnen Ländern. By Blasius, R. and von Hayek, G. Ornis, vol. 1, no. 1, pp. 55–67.

1886

1. The rabbits of Ontario, Canada. Forest and Stream, vol. 25, no. 24, p. 466.
2. Description of a new species of chipmunk from California (*Tamias macrorhabdotes* sp. nov.). Proc. Biol. Soc. Washington, vol. 3, pp. 25–28, 1 fig. in text.
3. Circular to the keepers of lights. U. S. Dept. Agric., Div. Entomology, Circ. no. 24, pp. 1–4.
4. Preliminary description of a new species of Aplodontia (A. major sp. nov., 'California show'tl,' 'mountain beaver'). Science, vol. 7, no. 161, p. 219.
5. Description of a new subspecies of the common eastern chipmunk. Amer. Nat., vol. 20, no. 3, pp. 236–242.
6. Preliminary description of a new squirrel from Minnesota (Sciurus carolinensis hypophaeus sp. nov.). Science, vol. 7, no. 167, p. 351.
7. Description of a new species of Aplodontia from California. Ann. New York Acad. Sci., vol. 3, no. 10, pp. 312–328, pls. 19–20, 1 fig. in text.
8. Robbins and cherries. Forest and Stream, vol. 26, no. 24, p. 468.
9. Circular on the food habits of birds. U. S. Dept. Agric., Div. Ornith. and Mamm., Circ. no. 1 [4 pp.].
10. Circular on the English sparrow. (Passer domesticus). U. S. Dept. Agric., Div. Ornith. and Mamm., Circ. no. 2 [1 p.].
11. Early occurrence of the great white egret at Washington, D. C. Forest and Stream, vol. 26, no. 26, p. 508.
12. Circular on the economic relations of mammals. U. S. Dept. Agric., Div. Ornith. and Mamm., Circ. no. 3 [4 pp.].
13. Hibernation of bats. Science, vol. 8, no. 190, p. 281.
14. Description of a new species of bat from the western United States. (*Vespertilio ciliolabrum* sp. nov.). Proc. Biol. Soc. Washington, vol. 4, pp. 1–4.
15. [Letter]. *In* Papers on the destruction of native birds, Jour. Cincinnati Soc. Nat. Hist., vol. 9, no. 3, pp. 217–219.
16. Circular to postmasters in relation to the English Sparrow (request for information). Circ. no. 7, U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., (1 p.) [not seen by me].

17. Preliminary description of a new pocket gopher from California. Science, vol. 8, no. 203, p. 588.
18. Circular on the geographical distribution and migration of North American birds for 1886. U. S. Dept. Agric., Div. Entomology, Circ. no. 27, pp. 1–4.
19. Instructions for the collection of stomachs. U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., Circ. no. 4 [1 p.].
20. Circular to rice growers. U. S. Dept. Agric., Div. Ornith. and Mamm., Circ. no. 5 [1 p.].
21. Description of a newly-born lynx. Bull. Nat. Hist. Soc. New Brunswick, vol. 1, bull. no. 5, pp. 10–13, 1 pl.
22. [Letters to Fred. Mather dated August 16 and August 22, 1882, identifying a smal Adirondack fish and *Uranidea gracilis*.] *In* Fred. Mather's "Adirondack Fishes", 12th Rept. N. Y. State Adirondack Survey: Appendix (Zoology), pp. 8–9, 1886. "Printed in advance of the Report" [not seen by me].

1887

1. The English sparrow.—(*Passer domesticus*.). The American Field, p. 153 [Letter to editor] [only clipping seen by me.]
2. Circular on the geographical distribution and migration of North American birds for 1887. U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., Circ. no. 8 [4 pp.].
3. Description of a new species of wood-rat from Cerros Island, off Lower California (*Neotoma bryanti* sp. nov.). Amer. Nat., vol. 21, no. 2, pp. 191–193.
4. Australian rabbits. Colman's Rural World, March 3, 1887. [C. H. M.] [only clipping seen by me.]
5. Description of a new mouse from New Mexico. *Hesperomys* (*Vesperimus*) *Anthonyi* sp. nov. Proc. Biol. Soc. Washington, vol. 4, pp. 5–7.
6. Another specimen of Bachman's warbler. Auk, vol. 4, no. 3, p. 262.
7. Animal Life on the Earth. Appleton's New Physical Geography, pp. 100–103, illus. [not seen by me].
8. Geographical Distribution of Mammalia [with map showing distribution of animal life]. Appleton's New Physical Geography, pp. 103–106, illus. [not seen by me].
9. Mammals of the United States. Appleton's New Physical Geography, pp. 134–137, illus. [not seen by me].
10. [Letter] *In* Tough luck in the Tuckiseegee. Forest and Stream, vol. 29, no. 6, p. 104.
11. Do any Canadian bats migrate? Evidence in the affirmative. Trans. Roy. Soc. Canada, vol. 5, section 4, pp. 85–87. [Abstract published in Proc. American Assoc. Adv. Sci., vol. 35, p. 269.]
12. Report of the Ornithologist and Mammalogist [for 1886]. *In* Rept. Commissioner of Agriculture, pp. 227–258, col. map, 2 figs. in text.

1888

1. What birds indicate proximity to water, and at what distance? Auk, vol. 5, no. 1, p. 119.
2. Economic Ornithology. A Reply. Audubon Magazine, Vol. 1, pp. 284–285 [not seen by me].
3. Description of a new fox from southern California. *Vulpes macrotis* sp. nov. Proc. Biol. Soc. Washington, vol. 4, pp. 135–138.
4. Eutheia canora from Sombrero Key, Florida—a bird new to the United States. Auk, vol. 5, no. 3, p. 322.
5. Description of a new prairie meadow mouse (Arvicola austerus minor) from Dakota and Minnesota. Amer. Nat., vol. 22, no. 259, pp. 598–601, 4 figs. in text.
6. Description of a new red-backed mouse (Evotomys dawsoni) from the headwaters of Laird River, Northwest Territory. Amer. Nat., vol. 22, no. 259, pp. 649–651, 2 figs. in text.

7. Description of a new species of field-mouse (Arvicola pallidus) from Dakota. Amer. Nat., vol. 22, no. 260, pp. 702–705, 4 figs. in text.
8. Description of the breeding plumage of Chadbourne's field sparrow (*Spizella arenacea*), with evidence of its specific distinctness. Auk, vol. 5, no. 4, pp. 402–403.
9. Description of a new species of meadow mouse from the Black Hills of Dakota. Amer. Nat., vol. 22, no. 262, pp. 934–935, 1 fig. in text.
10. Species and subspecies: a reply to Mr. Conn. Science, vol. 12, no. 305, p. 279.
11. Grasshoppers and hawks. Forest and Stream, vol. 31, no. 23, pp. 455–456.
12. Description of a new spermophile from California. Ann. New York Acad. Sci., vol. 4, pp. 317–321, 2 figs. in text.
13. Remarks on the fauna of the Great Smoky Mountains; with description of a new species of red-backed mouse (Evotomys carolinensis). Amer. Jour. Sci., 3d ser., vol. 36, no. 216, pp. 458–460.
14. Report on bird migration in the Mississippi Valley . . . by W. W. Cooke. Edited and revised by Dr. C. Hart Merriam. U. S. Dept. Agric., Div. Econ. Ornith., Bull. no. 2, 313 pp., 1 col. map.
15. Report of the Ornithologist and Mammalogist [for 1887]. *In* Rept. Commissioner of Agriculture. Washington: Govt. Print. Off., pp. 399–456, 3 ills. [C. H. M.]
16. Introduced pheasants [see special reports, pp. 484–488, *in* Rept. Ornith. and Mamm. for 1887].
17. The mink (*Lutreola vison*) [see special reports, pp. 488–490, 1 ill., *in* Rept. Ornith. and Mamm. for 1887].
18. *Mammals*. *In* Professor Baird in science. By Wm. H. Dall. Bull. Philosophical Soc. Washington, vol. 10, pp. 63–65 [see note in Merriam's personal scrapbook ascribing authorship to Merriam].

1889

1. A correction: Arvicola (Chilotus) pallidus. Amer. Nat., vol. 23, no. 265, p. 60, 4 figs. in text.
2. [Letter from on occurrence of Cuterebrae in squirrels.] *In* On the emasculating bot-fly. Insect Life, vol. 1, no. 7, p. 215.
3. Circular on Killdeer Plover. Circ. no. 10, U. S. Dept. Agric., Div. of Econ. Ornith. and Mamm., (1 p.) [not seen by me].
4. That new Pika-Rel. American Angler, vol. 15, p. 211 [not seen by me].
5. Brief directions for the measurement of small mammals and the preparation of museum skins. U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., Circ. no. 11, pp. 1–4, 4 figs.
6. Report of the Ornithologist and Mammalogist [for 1888]. *In* Rept. Commissioner of Agriculture, pp. 477–536, 3 figs. in text.
7. A hawk bearing a legend. Auk, vol. 6, no. 3, p. 276.
8. Revision of the North American pocket mice. North Amer. Fauna no. 1, pp. vii + 36, pls. 1–4.
9. Descriptions of fourteen new species and one new genus of North American mammals. North Amer. Fauna no. 2, pp. v + 52, pls. 1–8, 7 figs. in text.
10. Who discovered the teeth in Ornithorhynchus? Nature [London], vol. 41, no. 1045, p. 11.
11. Who discovered the teeth in Ornithorhynchus? Nature [London], vol. 41, no. 1051, p. 151.
12. Report—Geography of life. Natl. Geogr. Mag., vol. 1, no. 2, pp. 160–162.
13. Letter from [*In* Prospectus of Nehrling's North American Birds] [Pamphlet], p. [3].

1890

1. Results of a biological survey of the San Francisco Mountain region and desert of the Little Colorado, Arizona. North Amer. Fauna no. 3, pp. vii + 102, 119–136, frontispiece, pls. 1–11, 5 maps, 2 figs.

2. Descriptions of twenty-six new species of North American mammals. North Amer. Fauna no. 4, pp. v + 60, pls. 1–3, 3 figs. in text.
3. Report of the Ornithologist and Mammalogist [for 1889]. *In* First Rept. Sec. Agric., pp. 363–376, 2 col. pls. [Included are 2 reports by Fisher, A. K.]
4. L'Ornithologie et la Mammalogie Économiques. Commissariat Gen. des Etats-Unis d'Amerique a l'Expos. Univ. de 1889, a Paris. Productions Agricoles des Etats-Unis, pp. 39–46, (Paris, 1890). English edition (with slightly different title and form and condensation of tables) published in Rept. U. S. Commrs. Paris Expos. of 1889, vol. 5; Agriculture, pp. 779–781 (1891) [not seen by me].
5. [Undesirability of bounty on English Sparrows: Letter to Geo. B. Sennett.] Ann. Rept. Pennsylvania State Board Agric., pp. 5–9, (1890) [not seen by me].

1891

1. [Correspondence] The owl and the sparrow. Garden and Forest, no. 152, p. 35.
2. Directions for collecting the stomachs of birds. U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., Circ. no. 12 [4 pp.].
3. Results of a biological reconnaissance of south-central Idaho. North Amer. Fauna, no. 5, pp. vii + 108, 115–132, pls. 1 (col. frontispiece)—4, 4 figs.
4. Report of the Ornithologist and Mammalogist [for 1890]. *In* Rept. Sec. Agric., pp. 277–285.
5. Birds which feed on mulberries. *In* Rept. Sec. U. S. Dept. Agric. [for 1890], p. 285.

1892

1. The zoology of the Snake Plains of Idaho. Amer. Nat., vol. 26, no. 303, pp. 218–222.
2. The geographic distribution of life in North America with special reference to the Mammalia. Proc. Biol. Soc. Washington, vol. 7, pp. 1–64, col. map. [Republished, without map, in Ann. Rept. Smithson. Inst. for 1891, pp. 365–415.]
3. The dwarf screech owl (*Megascops flammeolus idahoensis* Merriam). Auk, vol. 9, no. 2, pp. 169–171.
4. Plants of the Pribilof Islands, Bering Sea. Proc. Biol. Soc. Washington, vol. 7, pp. 133–150.
5. Description of a new prairie dog (Cynomys mexicanus) from Mexico. Proc. Biol. Soc. Washington, vol. 7, pp. 157–158.
6. The Carolina paroquet (*Conurus carolinensis*) in Missouri. Auk, vol. 9, no. 3, p. 301.
7. Description of a new genus and species of murine rodent (*Xenomys nelsoni*) from the state of Colima, western Mexico. Proc. Biol. Soc. Washington, vol. 7, pp. 159–163.
8. Descriptions of nine new mammals collected by E. W. Nelson in the states of Colima and Jalisco, Mexico. Proc. Biol. Soc. Washington, vol. 7, pp. 164–174.
9. The occurrence of Cooper's lemming mouse (*Synaptomys cooperi*) in the Atlantic states. Proc. Biol. Soc. Washington, vol. 7, pp. 175–177.
10. [With Allen, J. A., and Gill, Theo.] The fur seal of Guadalupe Island, off Lower California. *In* Fur-seal arbitration. Appendix to the case of the United States . . . Washington, D. C.: Govt. Print Off., vol. 1, p. 586.
11. Circular letter of Dr. C. Hart Merriam. *In* Fur-seal arbitration. Appendix to the case of the United States . . . . Washington, D. C.: Govt. Print. Off., vol. 1, pp. 414–417. [Reprinted in Rept. U. S. Treasury, 54th Cong., 1st sess., doc. 137, part 1, pp. 83–86.]
12. [With Mendenhall, T. C., *et al.*] Part First. Relating to historical and jurisdictional questions. Fur-seal arbitration. Case of the United States before the tribunal to convene at Paris. . . . vol. 2, pp. 9–310.
13. [With Mendenhall, T. C., as sr. author] Report of the United States Bering Sea commissioners. Fur-seal arbitration. Case of the United States before the tribunal to convene at Paris. . . . vol. 2, pp. 311–396, 2 pls. Reprinted in part in vol. 9, pp. 75–78, 1893.

14. [With Mendenhall, T. C., *et al*] Bering Sea commission joint report. U. S. no. 2 (1893). Behring Sea arbitration. Fur seal arbitration. Proceedings of the tribunal of arbitration, . . . vol. 6, pp. 11–12.
15. Report of the Ornithologist and Mammalogist [for 1891]. *In* Rept. Sec. Agric., pp. 267–271.
16. Ornithology, mammalogy and bird migration. 19th Ann. Rept. New Jersey State Board of Agriculture, pp. 145–152 [only separate seen by me].

1893

1. [Field notes by C. H. M. *in* Stejneger's report on the reptiles and batrachians] *In* The Death Valley expedition . . . . North Amer. Fauna no. 7, part 2, pp. 159–228.
2. Notes on the distribution of trees and shrubs. . . . *In* The Death Valley expedition. . . . North Amer. Fauna no. 7, part 2, pp. 285–343.
3. Notes on the geographic and vertical distribution of cactuses, yuccas, and agave. . . . *In* The Death Valley expedition. . . . North Amer. Fauna no. 7, part 2, pp. 345–359, pls. 7–14.
4. Description of a new kangaroo rat from Lower California (Dipodomys merriami melanurus subsp. nov.) collected by Walter E. Bryant. Proc. California Acad. Sci., 2d ser., vol. 3, pp. 345–346.
5. Biology in our colleges: a plea for a broader and more liberal biology. Science, vol. 21, no. 543, pp. 352–355.
6. Rediscovery of the Mexican kangaroo rat, *Dipodomys phillipsi* Gray. Proc. Biol. Soc. Washington, vol. 8, pp. 83–96.
7. The faunal position of Lower California. Auk, vol. 10, no. 3, pp. 305–306.
8. Two new wood rats from the plateau region of Arizona (*Neotoma pinetorum* and *N. arizonæ*) with remarks on the validity of the genus Teonoma of Gray. Proc. Biol. Soc. Washington, vol. 8, pp. 109–112.
9. Descriptions of eight new ground squirrels of the genera *Spermophilus* and *Tamias* from California, Texas, and Mexico. Proc. Biol. Soc. Washington, vol. 8, pp. 129–138.
10. Preliminary descriptions of four new mammals from southern Mexico, collected by E. W. Nelson. Proc. Biol. Soc. Washington, vol. 8, pp. 143–146.
11. The yellow bear of Louisiana, *Ursus luteolus* Griffith. Proc. Biol. Soc. Washington, vol. 8, pp. 147–151.
12. Report of the Ornithologist and Mammalogist [for 1892]. *In* Rept. Sec. Agric., pp. 181–200.

1894

1. Preliminary descriptions of eleven new kangaroo rats of the genera Dipodomys and Perodipus. Proc. Biol. Soc. Washington, vol. 9, pp. 109–115.
2. Abstract of a study of the American wood rats, with descriptions of fourteen new species and subspecies of the genus Neotoma. Proc. Biol. Soc. Washington, vol. 9, pp. 117–128.
3. The water ouzel in the Coast Range south of Monterey, California. Auk, vol. 11, no. 3, p. 258.
4. Descriptions of four new pocket mice from Lower California, collected by Walter E. Bryant. Proc. California Acad. Sci., 2d ser., vol. 4, pp. 457–462.
5. A new subfamily of murine rodents—the Neotominæ—with description of a new genus and species and a synopsis of the known forms. Proc. Acad. Nat. Sci. Philadelphia, vol. 46, pp. 225–252, pl. 9, 5 figs.
6. Description of eight new pocket mice (genus Perognathus). Proc. Acad. Nat. Sci. Philadelphia, vol. 46, pp. 262–268, 7 figs.
7. Laws of temperature control of the geographic distribution of terrestrial animals and plants. Natl. Geogr. Mag., vol. 6, pp. 229–238, pls. 12–14.
8. Report of the Ornithologist and Mammalogist [for 1893]. *In* Rept. Sec. Agric., pp. 227–234, col. map.

1895

1. Zoölogical nomenclature. Science, n. s., vol. 1, no. 1, pp. 18–19.
2. Laws of temperature control of the geographic distribution of life. Science, n. s., vol. 1, no. 2, pp. 54–56. [C. H. M.]
3. The LeConte thrasher, *Harporhynchus lecontei*. Auk, vol. 12, no. 1, pp. 54–60, 2 ills.
4. Monographic revision of the pocket gophers family Geomyidae (exclusive of the species of Thomomys). North Amer. Fauna no. 8, pp. 1–258, frontispiece, pls. 1–19, 4 col. maps, 71 figs.
5. Unity of nomenclature in zoölogy and botany. Science, n. s., vol. 1, no. 6, pp. 161–162.
6. [Review of] The birds of eastern Pennsylvania and New Jersey. . . . By Witmer Stone. . . . Science, n. s., vol. 1, no. 7, pp. 187–188.
7. [Review of] Visitor's guide to the local collection of birds in the Museum of Natural History, New York City. By Frank M. Chapman. . . . Science, n. s., vol. 1, no. 7, p. 189.
8. The earliest generic name of an American deer. Science, n. s., vol. 1, no. 8, p. 208.
9. Death of George N. Lawrence. Science, n. s., vol. 1, no. 10, pp. 268–269.
10. [Review of] Brisson's genera of mammals, 1762. Science, n. s., vol. 1, no. 14, pp. 375–376.
11. [Review of vol. 2] The royal natural history. Edited by Richard Lydekker. . . . Science, n. s., vol. 1, no. 14, pp. 387–389.
12. [Review of parts one and two] The book of antelopes. By P. L. Sclater and Oldfield Thomas. . . . Science, n. s., vol. 1, no. 14, pp. 389–390 [C. H. M.].
13. [Review of] A handbook of the birds of eastern North America. By Frank M. Chapman. . . . Science, n. s., vol. 1, no. 16, pp. 437–439.
14. [Review of] The land-birds and game-birds of New England. By H. D. Minot. . . . Science, n. s., vol. 1, no. 18, pp. 495–496.
15. [Review of] The central nervous system of Desmognathus fusca. By Pierre A. Fish. . . . Science, n. s., vol. 1, no. 18, p. 496.
16. [Review of part eleven] Our native birds of song and beauty. By H. Nehrling. . . . Science, n. s., vol. 1, no. 21, pp. 577–578.
17. [Review of] Birdcraft, a field book of two hundred song, game and water birds. By Mabel Osgood Wright. . . . Science, n. s., vol. 1, no. 23, p. 635.
18. [Review of] The ornithology of Illinois; descriptive catalogue. By Robert Ridgway. . . . Science, n. s., vol. 1, no. 24, pp. 661–662.
19. [Reply to Elliot Coues] *In* The illustrations in the Standard Natural History. Science, n. s., vol. 1, no. 25, pp. 682–684.
20. [Review of] [The Norway lemming] Myodes lemmus, its habits and migrations in Norway, by R. Collett. . . . Science, n. s., vol. 1, no. 25, pp. 690–692.
21. [Review of] On the [harvest mice] species of the genus Reithrodontomys. By J. A. Allen. . . . Science, n. s., vol. 1, no. 26, pp. 720–721.
22. [Review of] The royal natural history. Edited by Richard Lydekker. Vol. III. . . . Science, n. s., vol. 2, no. 27, pp. 18–21.
23. The generic name Anisonyx pre-occupied. Science, n. s., vol. 2, no. 30, p. 107.
24. Occurrence of the Siberian lemming-vole (Lagurus) in the United States. Amer. Nat., vol. 29, no. 344, pp. 758–759.
25. [Review of part twelve] North American birds: By H. Nehrling. . . . Science, n. s., vol. 2, no. 38, pp. 382–383.
26. [Review of] On a collection of mammals from Arizona and Mexico. . . . By J. A. Allen. . . . Science, n. s., vol. 2, no. 39, pp. 417–418.
27. Bats of Queen Charlotte Islands, British Columbia. Amer. Nat., vol. 29, no. 345, pp. 860–861.
28. [Review of] List of mammals collected in the Black Hills region of South Dakota and in western Kansas. . . . By J. A. Allen. . . . Science, n. s., vol. 2, no. 41, p. 490.
29. Revision of the shrews of the American genera Blarina and Notiosorex. North Amer. Fauna no. 10, pp. 5–34, pls. 1–3, 2 figs.

30. Synopsis of the American shrews of the genus Sorex. North Amer. Fauna no. 10, pp. 57–124, pls. 4, 7–12.
31. Report of the chief of the Division of Ornithology and Mammalogy [to June 30, 1894]. *In* Rept. Sec. Agric., pp. 167–169.
32. The geographic distribution of animals and plants in North America. *In* Yearbook U. S. Dept. Agric. [for] 1894, pp. 203–214, fig. 20.
33. Report of the chief of the Division of Ornithology and Mammalogy. [to June 30, 1895] *In* Rept. Sec. Agric., pp. 175–178.

1896

1. [Review of] Hunting in many lands . . . Boone and Crockett Club. . . . Science, n. s., vol. 3, no. 59, p. 246.
2. [In scientific notes and news.] A permanent scientific head for the U. S. Department of Agriculture. Science, n. s., vol. 3, no. 60, pp. 278–279 [C. H. M.].
3. [Review of] A handbook to the British mammalia. By R. Lydekker. . . . Science, n. s., vol. 3, no. 61, pp. 325–326.
4. Revision of the lemmings of the genus *Synaptomys*, with descriptions of new species. Proc. Biol. Soc. Washington, vol. 10, pp. 55–64, 5 figs.
5. [Review of] A review of the weasels of eastern North America. By Outram Bangs. . . . Science, n. s., vol. 3, no. 66, p. 525.
6. [Review of] The polar hares of eastern North America. . . . By Samuel N. Rhoads. . . . Science, n. s., vol. 3, no. 67, pp. 564–565.
7. [Review of part thirteen] North American birds. By H. Nehrling. . . . Science, n. s., vol. 3, no. 67, pp. 565–566.
8. [Review of parts three, four and five] The book of antelopes. By P. L. Sclater and Oldfield Thomas. . . . Science, n. s., vol. 3, no. 67, p. 566.
9. Preliminary synopsis of the American bears. Proc. Biol. Soc. Washington, vol. 10, pp. 65–83, pls. 4–6, figs. 6–17.
10. American polar hares: a reply to Mr. Rhoads. Science, n. s., vol. 3, no. 75, p. 845.
11. [Review of part fourteen] Our native birds of song and beauty. By H. Nehrling. . . . Science, n. s., vol. 3, no. 78, p. 932.
12. [Review of] Die Haustiere und ihre bezeihungen zur Wirtschaft des Menchen. Eine geographische Studie, von Eduard Hahn. . . . Science, n. s., vol. 3, no. 78, p. 932.
13. Synopsis of the weasels of North America. North Amer. Fauna no. 11, pp. 1–44, frontispiece, pls. 1–5, 16 figs. in text.
14. [Review of] The royal natural history: mammals. By Richard Lydekker. . . . Science, n. s., vol. 4, no. 82, p. 116.
15. Meeting of the Mazamas at Crater Lake, Oregon. Science, n. s., vol. 4, no. 91, pp. 446–448.
16. [Review of] Life histories of North American birds. . . . By Charles Bendire. . . . Science, n. s., vol. 4, no. 96, pp. 657–658.
17. A new fir from Arizona, *Abies arizonica*. Proc. Biol. Soc. Washington, vol. 10, pp. 115–118, figs. 24–25, in text.
18. *Romerolagus nelsoni*, a new genus and species of rabbit from Mt. Popocatepetl, Mexico. Proc. Biol. Soc. Washington, vol. 10, pp. 169–174, figs. 33–34.
19. Report of the Division of Ornithology and Mammalogy [to June 30, 1896]. *In* Rept. Sec. Agric., pp. 23–25.
20. Circular in relation to bounties on mammals and birds. Circ. no. 19, U. S. Dept. Agric., Div. Econ. Ornith. and Mamm., (1 p.) [not seen by me].

1897

1. [Review of] A geographical history of mammals. [By] R. Lydekker. . . . Science, n. s., vol. 5, no. 105, pp. 26–32.
2. Range of the pronghorn antelope in 1896. Forest and Stream, vol. 48, no. 1, p. 6 [only separate seen by me].

3. [Review of] A popular handbook of the ornithology of eastern North America. By Thomas Nuttall. . . . Science, n. s., vol. 5, no. 107, pp. 110–111.
4. Henrich Gätke. Science, n. s., vol. 5, no. 109, p. 181 [C. H. M.].
5. [Obituary of] Charles E. Bendire. Science, n. s., vol. 5, no. 111, pp. 261–262.
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7. Revision of the coyotes or prairie wolves, with descriptions of new forms. Proc. Biol. Soc. Washington, vol. 11, pp. 19–33.
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9. A new coyote from southern Mexico. Proc. Biol. Soc. Washington, vol. 17, p. 157.
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6. The King cameos of Audubon. Auk, vol. 45, no. 4, pp. 448–450, pl. 7.
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10. Work of the Biological Survey in the interests of agriculture and game protection. *In* Message from the President of the United States . . . . 60th Cong. 1st sess., Senate doc. no. 132, pp. 2–29, col. pls. 4–6. [C. H. M.]

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3. The California ground squirrel. U. S. Dept. Agric., Bur. Biol. Surv., Circ. no. 76, pp. 1–15, figs. 1–4 in text.
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3. [Testimony of] *In* U. S. Congress. House Committee on Expenditures in Department of Commerce and Labor. To investigate the fur-seal industry of Alaska, Hearings, 62d Cong., 1st sess., on H. R. 73. Washington: Govt. Print. Off., pp. 692–699.

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3. Descriptions of thirty apparently new grizzly and brown bears from North America. Proc. Biol. Soc. Washington, vol. 27, pp. 173–196.
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2. Localities from which big bears are needed. Boone and Crockett Club, Report of the Game Preservation Committee 1915, pp. 45–47.
3. The big bears of western North America, with special reference to their distribution. Science, n. s., vol. 42, pp. 659–660.

1916

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3. Indian names in the Tamalpais region. California Out-of-doors, April, p. 118.
4. *Ovis sheldoni*, a new mountain sheep from Sierra del Rosario, Sonora, Mexico. Proc. Biol. Soc. Washington, vol. 29, pp. 129–132.
5. Nineteen apparently new grizzly and brown bears from western America. Proc. Biol. Soc. Washington, vol. 29, pp. 133–154.
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3. Was that bear clipped? Recreation, vol. 56, no. 3, p. 129.
4. The giant manzanitas of Clear Lake, California. Jour. Amer. Mus., vol. 17, no. 6, pp. 398–402, with 5 ills. from photographs by author.
5. [Statement by, before U. S. Geographic Board] Shall the name of Mount Rainier be changed? Washington, Govt. Print. Off., 10 pp.
6. How Mah'-tah, the turkey buzzard, lost his speech. Amer. Mus. Jour., vol. 17, no. 8, p. 557, 1 ill.

1918

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2. John Muir misquoted. The Outlook, vol. 118, April 24, p. 678.
3. Two new manzanitas from the Sierra Nevada of California. Proc. Biol. Soc. Washington, vol. 31, pp. 101–103, pls. 1–5.
4. The acorn, a possibly neglected source of food. Natl. Geogr. Mag., vol. 34, no. 2, pp. 129–137, 8 ills. in text.

1919

1. Grove Karl Gilbert, the man. Sierra Club Bull., vol. 10, no. 4, pp. 391–396, pls. 220 (frontispiece), 221.
2. The sandhill crane in northeastern California. Condor, vol. 21, no. 2, p. 87.
3. Criteria for the recognition of species and genera. Jour. Mamm., vol. 1, no. 1, pp. 6–9.
4. Is the jaguar entitled to a place in the California fauna? Jour. Mamm., vol. 1, no. 1, pp. 38–40.
5. Why should every specimen be named? Jour. Mamm., vol. 1, no. 1, pp. 41–42.

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3. Our largest bears as shown in skulls. Outdoor Life, vol. 48, no. 6, pp. 388–390, 8 ills.

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2. Early records of buffalo in "California" [= Nevada, Utah and southwestern Wyoming]. Jour. Mamm., vol. 3, no. 1, pp. 54–55. [Brackets in title placed by C. H. M.]

3. Distribution of grizzly bears in U. S. with map by C. H. M. Outdoor Life, vol. 50, no. 6, p. 405 [not seen by me].

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2. Misuse of the word "creation" by naturalists. Science, n. s., vol. 57, no. 1487, p. 742.
3. Earliest crossing of the deserts of Utah and Nevada to southern California: Route of Jedediah S. Smith in 1826. California Hist. Soc. Quarterly, vol. 2, no. 3, pp. 228–236, 1 ill. (map).
4. First crossing of the Sierra Nevada: Jedediah Smith's trip from California to Salt Lake in 1827. Sierra Club Bull., vol. 11, no. 4, pp. 375–379.
5. Erroneous identifications of "copper effigies" from the Mound City group. Amer. Anthrop., n. s., vol 25, no. 3, pp. 424–425.

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2. Baird the naturalist. Scientific Monthly, vol. 18, pp. 588–595.
3. Forced Allotments. *In* A cycle on the American Indian. The Forum, N. Y., vol. 72, no. 5, pp. 712–713.
4. Cotton tails. Letter to Editor of Game Breeder on use of word "Rabbit." Game Breeder, N. Y., pp. 54 and 56 [not seen by me].
5. Statement of the chairman of the United States Geographic Board. *In* [pamphlet] The great myth—"Mount Tacoma" . . . . Olympia Chamber of Commerce. . . . Olympia, Washington, pp. 27–28.
6. Shall the name of Mount Rainier be changed? *In* [pamphlet] . . . Proposal to change the name of Mount Rainier . . . Lowman and Hartford Company, Seattle.
7. [Report of Chairman] Report of United States Geographic Board on S. J. R. 64 . . . to change the name of "Mount Rainier" . . . Washington: Govt. Print. Off., pp. v + 8.

1925

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2. [Two letters *in*] Recent evidence of grizzly bear in the Sierra. Sierra Club Circular, no. 12 [pp. 2–4].
3. [Letter of transmittal, pp. 3–4; report of U. S. Geographic Board, pp. 4–9; testimony of C. Hart Merriam, pp. 21–27] *In* U. S. Congress. House. Committee on Public Lands. Changing name of Mount Rainier. Hearings, 68th Cong., 2d sess., on S. J. R. 64. Washington: Govt. Print. Off.

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2. Source of the name Shasta. Jour. Washington Acad. Sci., vol. 16, no. 19, pp. 522–525.
3. [Testimony of] *In* U. S. Congress. House. Committee on Indian Affairs. Indian tribes of California. Hearings, 69th Cong., 1st sess., on H. R. 8036 and H. R. 9497. Washington: Govt. Print. Off., pp. 50–63.
4. [Testimony of] *In* U. S. Congress. House. Committee on Indian Affairs. Reservation courts of Indian offenses. Hearings, 69th Cong., 1st sess., on H. R. 7826. Washington: Govt. Print. Off., pp. 6–18.
5. Measurement of bears' skulls. Outdoor Life (2 fig.) [not seen by me].
6. The classification and distribution of the Pit River Indian tribes of California. Smithsonian Misc. Coll. (publication 2874), vol. 78, no. 3, pp. 1–52, frontispiece [col. map], pls. 1–27.

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2. An-nik-a-del | the History of the Universe | as told by the Mo-deś-se | Indians of California | Recorded and Edited by | C. Hart Merriam, M. D. | seal | 1928 | The Stratford company, Publishers | Boston, Massachusetts. Pp. xi + 166, frontispiece, 6 ills.

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3. Ursus holzworthi, a new grizzly from the Talkeetna Mountains, Alaska. Proc. Biol. Soc. Washington, vol. 42, pp. 173–174, pls. 4–7.

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3. Concentrations of remnants of Indian tribes in northwestern California. Science, vol. 71, no. 1847, p. 546.
4. A remarkable case of word borrowing among California Indians. Science, vol. 71, no. 1847, p. 546.
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6. A nest of the California gray squirrel (Sciurus griseus). Jour. Mamm., vol. 11, no. 4, p. 494, pl. 25.
7. The white-tailed kite in Marin County, California. Condor, vol. 32, no. 6, p. 301.
8. [Introduction to] The Wilderness of Denali. By Charles Sheldon. Pp. xvii–xxv. [Whole book edited by C. Hart Merriam and E. W. Nelson.]

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1932

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2. Roosevelt, the naturalist. Science, vol. 75, no. 1937, pp. 181–183.
3. [The bears of America] *In* Records of North American big game . . . Boone and Crockett Club. New York. The Derrydale Press, pp. 135–145, 6 ills.

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WILDLIFE CONSERVATION AS AFFECTED BY AMERICAN INDIAN AND CAUCASIAN CONCEPTS

By Clifford C. Presnall

During the last half century the conservation of wildlife in the United States has advanced farther and more rapidly than that of any other natural resource except forests. One phase of the problem, however, dealing with game protection on Indian lands was seriously neglected until recently because of indifference and a failure to recognize and deal with the fundamental differences in wildlife concepts held by American Indians and Caucasians. Stated briefly, the Indian thinks of wildlife as a utility; the Caucasian regards it primarily as a source of pleasure. An understanding of these conflicting concepts and the reactions between them is the *sine qua non* of a successful game conservation program on Indian lands.

It is very difficult for one race of men to acquire a sympathetic understanding of the ideas and customs that motivate another race. The concepts originally held by Indians, before contact with the whites, are especially obscure to us since no living man, Indian or white, can have first hand knowledge of the subject. The Caucasian invasion of America not only altered all natural conditions, but also caused the Indians to modify their ideas, hence our information must come from the few writers who observed Indian wildlife customs before white influence had altered them.

Many of the early references to Indian wildlife customs are inaccurate, since writers of the 17th and 18th centuries, even as now, were prone to interpret Indian views in the light of their own cultural backgrounds. On the one hand there existed a school of romanticists, best exemplified by Baron Lahontan, to whom the Indian was the antithesis of all the meanness and corruption that prevailed in Europe at that time. Opposed to this school were the materialists. Between these two extremes there were few writers who held to a middle ground; a factual scientific viewpoint was almost unknown. From that day to the present the Indian race and the Indian problem in the United States have suffered because realism too often has been pushed to one side by the conflict between romanticism and materialism. Such a condition is especially harmful to wildlife conservation, which can only succeed when based upon facts.

It has been widely stated that the pre-Columbian abundance of wildlife in North America was due to conservation activities of the Indians, but little evidence can be found in support of this view. It is apparent that a majority of the Indians usually made conservative use of animal products in order to reduce the amount of hard and often dangerous work involved in securing them. The same motive frequently led to tribal regulation of hunting practices, such as the system of "beloved bear grounds", which Hawkins described in 1798, wherein the Creeks set aside bear preserves from which all hunting was periodically excluded so that the bears would increase enough to permit easy slaughter at certain periods. Somewhat similar communal restrictions on buffalo hunting by various Plains tribes were noted by Grinnell (1923), Hind (1860), Catlin (1926), and others. Cooper (1939) describes a well organized system of family trapping areas through-

out most of the wooded area of Canada east of Lake Winnipeg. It was based chiefly upon family control of definite areas that were closed to trapping every other year. Future supplies were assured by leaving an adequate supply of breeding animals. This system has also been described by Speck (1915) and Lahontan (1905). Although it resulted in conservation of fur animals, the Indians appear not to have had this purpose in mind. They were evidently seeking a reduction in the labor of trapping, and an increase in the success of their efforts, and, as will be shown later, they did not hesitate to deplete fur resources when the introduction of iron implements brought increased efficiency. An insight into Indian attitudes is furnished by a letter written by Father Joseph de la Roche Dallion in the 17th century, which appears in La Clercq (1881, p. 269). Speaking of the Hurons, an eastern Canadian tribe, Dallion wrote that whenever a community hunt took place, the animals of a given area were driven into an enclosure where all were killed whether or not they were needed, so that none would return to warn other animals of the danger from future impoundments.

A similar desire to capture game with the least possible effort, and without regard for the principles of conservation, was common among the Plains Indians. Raudot, in a letter written early in the 18th century (appearing in Kinietz 1940), describes large organized buffalo hunts among the Illinois Indians, where it was not uncommon to kill more animals than were needed, and to save only the tongues and flat sides of meat. The wasteful killing of buffalo, and to a lesser extent of antelope, deer, moose, and caribou, by driving them over precipices or into pounds, was recorded by Chittenden (1905), Alexander Henry (1901), Alexander Henry the younger (1897), Wissler (1910), Hind (1860), and Grinnell (1923). All agreed that waste of meat was common in these drives. The popular belief that Indians never wasted any parts of the animals they killed originated mainly during the period of the vanishing buffalo herds, when economy was a necessity. Wissler (1910) has pointed out that in earlier times of abundance meat and pelts were often wasted. This would be expected of any primitive race. Another practice that wasted game but saved the hunters much work was that of driving or rounding up game with fire. This method seems to have been used over much of North America, but was most common in the long-grass prairies, where the fires often got out of control and needlessly destroyed game and even Indian villages (Chittenden, 1905; Hennepin, 1903; Charlevoix, 1923; and Catlin, 1926).

Among the salmon-eating Indians of the Pacific there was an almost universal use of fish traps that were capable of wiping out an entire salmon run in a few seasons if they could have been used continuously (see Craig, 1940). Intermittant use was the aboriginal rule, however, because the demand for salmon seldom approached the available supply, and the traps were lifted during high water to avoid the labor of repairing or rebuilding them. Since the heaviest salmon runs occurred during high water, the salmon Indians have been romantically credited with conservation of fish, rather than realistically accepted as conservators of their own energy.

Therein lies the key to the game situation in North America before the white invasion. The human population was not large enough to exert harmful pressure upon animal populations, nor did there exist either the incentive or the means for rapidly harvesting more wildlife products than were needed for a hand-to-mouth existence. Wildlife was a necessary utility to the Indian, to be acquired by hard and dangerous work; whatever conservatism he displayed in capturing and using game was due largely to the universal human trait of avoiding unnecessary work. It seems likely that prior to the time of Columbus the mammalian populations of the western hemisphere had adjusted themselves to a fairly stable biotic balance, in which humans were subjected to much the same controls as were other species. This was drastically changed by the coming of the Caucasians, bringing an iron-age economy into a continent that was dominated by a stone-age culture.

The Europeans who invaded the New World had long since passed the stone-age with its concept of wildlife as a utility, and had developed a concept of wildlife as a source of pleasure. For many centuries hunting had been traditionally the prerogative of kings and nobility, even in the days of early Egypt, Babylonia, Assyria, and Persia. This principle was recognized in the later Roman Empire, as evidenced by the law of Commodus making it a penal offense to kill African lions even in self-defense, as they were reserved for imperial hunters. Charlemagne established royal bans against hunting save by titled subjects, and throughout feudal days the chase was largely monopolized by warriors and knights training for battle. As feudalism declined, hunting became a privilege of the moneyed man of leisure, but was considered unsuitable for the populace, as drawing them away from work and encouraging robbery. The idea that wildlife was a source of pleasure reserved to the privileged few reached its climax in the English game laws of the 15th, 16th, and 17th centuries.

Although both Caucasian and American Indian mores regarding wildlife had become firmly established before they met in the new world, there was no immediate conflict between them. Instead, both were nearly obscured by new ideas originating in the sociological explosion that accompanied the conquest of the western hemisphere. European wildlife mores were subordinated to a policy of ruthless exploitation of natural resources. Wildlife was a treasure to be looted rather than a crop to be harvested. Indian mores were also obscured and altered in the abrupt change from stone-age to iron-age economy. For example, the Iroquois, already embarked upon a policy of imperialism when the whites arrived, were quick to realize the advantages of iron implements and fire arms. They disregarded their age-old commandment against wholesale slaughter of animals, and traded their wealth of wildlife resources for weapons to use in subduing other tribes. These in turn quickly followed suit in an effort to survive or to strengthen themselves. A wave of wildlife destruction spread westward ahead of the actual white frontier as tribe after tribe bartered the future breeding stock of its fur resources for the immediate advantages of possessing fire arms and iron implements.

The more iron implements the Indians secured, the easier it was to hunt and

trap, and as each tribe depleted its own resources it was forced into war with western neighbors to secure more furs. Each tribe exploited its natural resources for the advantages of power to be gained over other tribes and the encroaching whites. The demand for iron implements was always greater than the supply, hence the wealth of furs flowed steadily eastward from a frontier that was a continuously forced westward. To increase the speed of such exploitation the whites introduced whiskey into the Indian trade, and thus very nearly accomplished the complete despoilation of a continent and a race (see Ferris, 1940, p. 287).

When the exploitation era finally drew to a close late in the 19th century and people began to realize that America's natural resources were not limitless, there was a gradual revival of earlier wildlife concepts among both whites and Indians. European and pre-Columbian Indian ideas had become greatly altered, but in the conservation movement that slowly developed to present proportions both races retained and revived the basic differences in their thoughts on wildlife: to the Indian it was still a utility, and to the white, a source of pleasure.

The upsurge of conservation thought in the United States, resulting in an unprecedented mass of fish and game legislation, has been well stated by Palmer (1912) and need not be repeated here. Less well-known and understood are the conflicts of ideas and resultant actions with respect to wildlife on Indian lands during the past three or four decades. Volumes have been written on the relationships between Indians and Caucasians, but a majority of such works must be discounted because of either a romantic or a materialistic bias. The few writers such as Kinney (1937), and Bailey (1937), who discuss socio-economic trends from a factual standpoint have not emphasized the wildlife angle, which was the most important single factor in the economy of many Indian tribes. Innis (1929), however, has thoroughly discussed the subject from the standpoint of the fur trade in Canada.

For many generations the Indians have been subject to vacillating and experimental policies: brute force followed by sentimental pampering; seizure of property offset by vicious doles; alternating periods of segregation and assimilation; a confusion of wardship and citizenship status; and endless strife between unreasoning prejudice and blind romanticism. Through it all the Indians have clung to their ancient fishing and hunting rights, finally coming to regard them as a symbol of their former freedom. Game was used for utilitarian purposes, to eke out a meager existence, until there was danger that the wildlife resources on many reservations would vanish, leaving the Indians with nothing upon which to exercise their rights. The Wheeler-Howard Act of 1934 gave almost complete self-government to the various tribes, and under its provisions they were encouraged in conservation; but even yet many of the Indians hesitate to restrict themselves in hunting and fishing, fearing it will offer an excuse for the whites to break the treaties which guarantee exclusive rights to reservation game, just as other promises were broken in the past.

Sportsmen adjacent to the reservations often are not fully informed as to the facts, and frequently do not know that Indian reservations are not subject to State game laws, and that tribes have authority to enact their own game ordi-

nances. Least of all do they appreciate the Indian concept of using game as a utility rather than as a pleasure.

The divergent concepts of the two races has resulted in an anomoly; the United States as a whole is perhaps the most progressive nation in the world as regards wildlife conservation, yet scattered throughout the West there are over 100 reservations, containing approximately 53 million acres, on which the general wildlife trend has been backward rather than forward. There are a few exceptions, and many tribes have recently showed an increasing desire to conserve their game. Some of the younger Indians are adopting the idea of hunting for pleasure, and it seems likely that a satisfactory solution of the problem will be found in a blending of Indian and Caucasian concepts. With proper management, certain tribes could secure a large part of their income and subsistence from wild furs and food, plus a fair revenue from the sale of sporting licenses. Conservation education is a paramount need in every grade of every Indian school, and among adult groups as well. Federal legislation such as will promote more rapid enactment of tribal game codes is another requisite. Above all, a factual viewpoint is necessary. In the present swing away from indifferent materialism there is real danger of overzealous romanticism. Successful wildlife management on Indian lands, as elsewhere, is dependent upon public recognition and application of scientific facts as opposed to sentimentality or prejudice. It is toward this end that of late the Fish and Wildlife Service, the Office of Indian Affairs, and the Indian tribes have been working together under an inter-bureau agreement approved by the Secretary of the Interior on August 7, 1941. Whatever conservation benefits may result from this cooperation will depend in large measure upon how well we can understand and appreciate the Indian attitude toward wildlife, as outlined in this paper. It may be summarized as follows; speaking now of the aboriginal Indian:

To the Indian the pursuit of game is a vocation; to us it is an avocation. The Indian regards wildlife as necessary to his existence, so much so that he worships it; he propitiates it with prayers before killing it, in order that future success in the hunt may be assured; he does not abhor the waste of game *per se*, but is opposed to a scarcity of game because that will force him to work harder; he objects to killing purely for sport, believing that it will anger the animal deities who will then hinder his business of hunting for food. There is nothing strange about all this; we look askance at a man who is profligate with his business, but think nothing of throwing money away on sports or avocations. Many of us are superstitious about ladders, mirrors, or black cats; we unconsciously make propitiations to them, not because of any regard for the cat or the ladder, but because we are fearful of our own future. So the Indian in sport may think nothing of gambling away his wife, but will avoid waste of energy in his business enterprise—his hunting; and he will hunt in certain ways because of superstitious fears about his future. The basic concepts of the two races are not very different; the Indian has merely applied vocation concepts to wildlife and we think of it as an avocation. The Indian's viewpoint was the correct one in his economy, and there are strong indications that our own viewpoint of wildlife as primarily

a luxury must be modified toward a utilitarian view if wildlife conservation is to achieve maximum usefulness in the future economy of the United States.

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MRS. M. A. MAXWELL, A PIONEER MAMMALOGIST

BY VIOLA S. SCHANTZ

The writer recently came across a most interesting and unique feminine personage in a publication of 1879 entitled *On the Plains and Among the Peaks*, by Mary Dartt, and published by Claxton, Remsen, and Haffelfinger, Philadelphia, Pennsylvania. This publication was hitherto apparently overlooked in reference to its mammalogy content.

In 1875, the state legislature of Colorado requested Mrs. M. A. Maxwell, of Boulder, Colorado, to place her Colorado animal exhibit in the Centennial Exhibition. That was probably the first such legislative action and serves to emphasize the importance of this exhibit at a national celebration.

Mrs. Maxwell was a pioneer woman of covered wagon days who made an extensive collection of the animals of Colorado, procuring by trapping, shooting, or poisoning, or by soliciting or buying from her acquaintances, specimens of nearly every kind of living creature found in that region.

This exceptional lady naturalist was commissioned by Colorado to illustrate with her collection the fauna of the state. Mrs. Maxwell complied by arranging over a hundred mammals and nearly 400 birds on a miniature landscape representing a plain and a rocky mountain side covered with evergreens. A little stream of water flowed down the mountain side into a miniature lake that was edged with ferns and growing grass.

The water and the bank were filled with aquatic creatures, such as fishes, turtles, beavers, muskrats, and waterfowl in their natural environment. A vine-fringed cave appeared between the cascade and the lake. Above it on the upper mountain side were groups of fierce bears, shy mountain sheep, savage mountain lions, and a lot of smaller animals all in lifelike action. On the space representing the Plains were huge buffaloes, elks, antelopes, and other native creatures.

Since this exhibit was designed and made, and the animals procured, mounted and arranged by Mrs. M. A. Maxwell, it was properly labeled "Woman's Work."

The newspapers had given her the title of "Colorado Huntress." In spite of this title, she was a kindly lady 4 feet, 11 inches tall, and "as shy as one of her own weasels."

Mrs. Maxwell had an irresistible scientific passion for wild creatures, to study

their habits and environment, and, with her artistic ability, reproduce their beautiful forms.

She began her career by assisting a school principal in putting up some bird specimens for his zoology department. Having previously examined some bird specimens of a German frontier "squatter" in the early stage of preparation for mounting, she was very much interested with the idea of learning to reproduce the characteristic grace of each animal. Mrs. Maxwell offered to pay the German almost any price for the necessary instructions. He agreed to give

Mrs. M. A. Maxwell

her a series of lessons at ten dollars apiece. When she arrived the next day for the first lesson, however, the German told her he had changed his mind "because she was a woman"! As he expressed it:

"Vimin is besser as men mit den hands in shmall verks. Ven you know dis pisness you makes de pirds and peasts so quicker as I; you leave me no more verk at all! Es is besser fur me I keeps vot I know mit mineself!" And she could not persuade him otherwise, assuring him she wished to learn only for her own gratification. Later she met a gentleman who was fond of field sports and who knew something of the principles of mounting specimens. He gave

her the benefit of his knowledge. Obtaining whatever printed matter she could and supplying her own ingenuity for the rest, she finally became very proficient in her work, according to Dr. Elliott Coues, U. S. A., who stated in an appendix of the publication *On the Plains and Among the Peaks* that he had the pleasure of inspecting Mrs. Maxwell's collection of animals of Colorado during the winter of 1876–1877 while the exhibit was in Washington.

Dr. Coues made repeated visits to see this collection of animals "mounted in a manner far superior to ordinary museum work." He remarked that he was glad to know a lady was capable of doing such work and enjoyed doing it. He regarded this as one of the most valuable single collections he had seen.

Dr. Coues made the following determinations from Mrs. Maxwell's mammal collection:

Felis concolor; Lynx canadensis; Lynx rufus; Canis lupus occidentalis; Vulpes macrurus; Gulo luscus; Putorius [= *Mustela*] *longicauda; Putorius* [= *Mustela*] *nigripes; Taxidea americana; Lutra canadensis; Ursus* (grizzly); *Euarctos* (black bears); *Bison americanus; Ovis montana; Antilocapra americana; Elaphus* [= *Cervus*] *canadensis; Cervus* [= *Odocoileus*] *macrotis; Cervus* [= *Odocoileus*] *virginianus; Sciurus aberti; Sciurus* [= *Tamiasciurus*] *fremonti; Tamias* [= *Eutamias*] *quadrivittatus; Tamias* [= *Citellus*] *lateralis; Spermophilus* [= *Citellus*] *grammurus; Spermophilus* [= *Citellus*] *tridecemlineatus; Cynomys ludovicianus; Arctomys* [= *Marmota*] *flaviventris; Zapus hudsonius; Dipodomys ordi; Geomys bursarius;* and *Castor canadensis.*

Dr. Coues supplemented the following identifications by some remarks based on his own observations in Colorado in 1876, and those partly derived from his conversation with Mrs. Maxwell:

Neotoma cinerea; Neotoma floridana; Hesperomys [= *Peromyscus*] *leucopus sonoriensis; Arvicola* [= *Microtus*] *riparius; Fiber* [= *Ondatra*] *zibethica; Lepus americanus bairdi; Lepus campestris; Lepus callotis texanus; Lepus* [= *Sylvilagus*] *sylvaticus nuttalli; Lagomys* [= *Ochotona*] *princeps; Canis latrans; Vulpes velox; Urocyon cinereoargentatus; Mustela* [= *Martes*] *americana; Mephitis mephitica;* and *Mephitis* [= *Spilogale*] *putorius.*

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THE BLOOD SUGAR CONCENTRATION IN ACTIVE AND HIBERNATING GROUND SQUIRRELS

By Rufus A. Lyman, Jr.

The phenomenon of hibernation has occupied the attention of many investigators for the last century and much literature on the subject has accumulated. General reviews of the facts and theories of hibernation have been published in this country by Rasmussen (1916), Gorer (1930), and Johnson (1931). Early investigators confined their studies largely to the measurement and evaluation of the external conditions under which hibernation occurs. Only comparatively recently have the physiological, and especially the biochemical, aspects of the problem been taken into consideration. The following briefly summarizes the literature on blood sugar changes in hibernating mammals.

Dubois (1894 and 1896) records the blood sugar concentration as traces to 9 mg per 100 cc of blood in the hibernating European marmot and 117 to 197 mg per 100 cc in the active animal. He infers from his experiments that there is no sugar in the blood of hibernating marmots and if any is found, it is due to errors in the technique of withdrawing the blood sample.

Cassidy, Dworkin, and Finney (1925 and 1927) have produced what they call an "artificial hibernation" in hibernants and non-hibernants. The body temperatures of dogs, cats, and marmots were lowered by means of cold baths. Then the blood sugar was reduced to the convulsive level by use of insulin. Such animals apparently lost their power of temperature control and, if kept in a cool environment, remained in this state of artificial hibernation as long as doses of insulin were given at suitable intervals. The animals could be aroused from this condition quite readily by injection of d-glucose.

It is noteworthy that most investigators have accepted the work of Dubois concerning the blood sugar concentration of a hibernating mammal, but have not measured it themselves. Obviously, if the blood sugar concentration during hibernation does not fall to or below the convulsive level, experiments on insulin hibernation throw no light on naturally occurring hibernation. The term "insulin hibernation" is then a misnomer and experiments on it are interesting studies on insulin shock and temperature regulation, not on hibernation.

Endres *et al.* (1930) give the average blood sugar concentration of five marmots in deep hibernation toward the end of March as 85.9 mg per 100 cc. Three of the same five animals, when active in June, had the following blood sugar concentrations: 161, 131, and 970 mg per 100 cc. The latter figure here seems questionable. The blood samples from active animals in these experiments were obtained by cardiac puncture without the use of an anaesthetic. The authors mention the fact that the animals struggled violently when the samples were taken. This alone might be sufficient to raise the blood sugar concentration considerably above normal.

Dische, Fleishmann, and Trevani (1931) measured the blood sugar concentration of ground squirrels (*Citellus citellus*) while the animals were awake, while

hibernating, and during artificial "insulin hibernation". Blood was obtained by decapitation. The blood sugar levels in active squirrels varied from 139 to 152 mg per 100 cc and that of hibernating individuals from 104 to 127 mg per 100 cc. During the artificial "insulin hibernation" the blood sugar concentration was 25 to 28 mg per 100 cc. Similar experiments on the European doormouse (*Glis glis*) showed the sugar level as 175 to 240 mg per 100 cc in the active animals and 60 to 100 mg per 100 cc during hibernation. No study of "insulin hibernation" was made on the doormouse. These authors further noted that large doses of insulin injected into hibernating squirrel often woke the animal by causing typical hypoglycemic convulsions. They concluded that, although the blood sugar concentration is decreased during hibernation, it never reaches the level produced in artificial "insulin hibernation". Normal hibernation is not therefore a result of increased insulin secretion.

Feinschmidt and Ferdmann (1932) found that seven ground squirrels (*Citellus guttatus*) that had been hibernating for many days had blood sugar concentrations ranging from 34 to 89 mg per 100 cc and averaging 49. Four animals that had been hibernating only a few days had blood sugar concentrations of 68 to 100 mg per 100 cc, with an average of 87. That of four animals immediately after being artificially roused from hibernation varied from 85 to 143 mg per 100 cc, with an average of 107. Three active animals used as controls had blood sugar concentrations of 145 to 209 mg per 100 cc, with an average of 181. Four hibernating marmots had blood sugar concentrations ranging from 44 to 107 mg per 100 cc, with an average of 68. That of three active marmots ranged from 115 to 157 mg per 100 cc and averaged 138. Blood samples for all of these experiments were obtained by decapitation, so measurements were not made on the same animal before and during hibernation. These figures indicate that the blood sugar concentration does not reach a very low level in the ground squirrel, at least, until the animal has been dormant for many days and sometimes not even then. Any change that is causally related to, or essential for, the hibernating condition must take place when hibernation begins. The evidence submitted by these authors suggests that an extremely low blood sugar concentration is not of prime importance in producing hibernation, but only appears when dormancy is prolonged.

The present study was undertaken in an effort to discover exactly what changes do occur in the blood sugar concentration of a mammal as it passes from the active to the hibernating condition. Since previous experimenters have found such great variations in blood sugar concentration among different animals of the same species, it was considered advisable to make determinations twice on the same animal, once when active and again when hibernating.

EXPERIMENTAL

Animals used.—In these experiments 20 ground squirrels, *Citellus tridecemlineatus tridecemlineatus* (Mitchill), were used. They were caught during the months of September and October, 1938, within the city limits of Lincoln, Nebraska. Throughout the following winter they were kept in separate wire cages when not hibernating and were fed a diet of oats and water. This diet

was sufficient to keep them in excellent condition—in fact, most squirrels gained weight during the winter. The squirrels, shortly after being captured, ranged in weight from just under 100 to just over 200 g, most of them being young animals. Practically all older animals had gone into hibernation several weeks earlier, and so were not available for this study.

Method of obtaining samples of blood from active squirrels.—In any study of hibernation, it is desirable to compare the hibernating animal with the same active animal. The term "active" as used here refers to an animal that is awake, but resting. Obviously there is no absolutely satisfactory method of obtaining blood from such an active animal. There are but two alternatives; either the blood sample may be drawn without regard for the animal's struggles and the resultant hyperglycemia, or an anaesthetic may be used. There are objections to both. Certainly it is unreasonable to compare the blood sugar concentration of a hibernating squirrel with that drawn from a violently struggling animal. On the other hand, the use of an anaesthetic is not altogether desirable (see below), but of necessity was adopted for these experiments.

Active squirrels were anaesthetized with veterinary nembutal (1 cc is equal to 1 gr nembutal) diluted immediately before administration with normal saline to one fifth strength. The first intraperitoneal dose on each squirrel was 30 mg per kg body weight. Either tolerance to nembutal was very rapidly built up or the nembutal solution rapidly deteriorated in strength. After two or three doses of 30 mg per kg, the dose was increased to 50 mg per kg. When this no longer had sufficient effect, the dose was increased to 75 mg per kg. Subsequent doses ran to 100 or 150 mg per kg. When such quantities were necessary 75 mg per kg were given at a single dose and then additional smaller doses given as needed. The anaesthesia lasted from two to five hours, most squirrels showing signs of recovery within three hours. Anaesthesia prevailed for at least one-half hour before the blood sample was drawn. This was assumed to be sufficient time for the blood sugar concentration to reach normal level after the animal had been excited by handling it and by making the injection of anaesthetic. Blood samples were drawn directly from the ventricle with a 2 cc dry hypodermic syringe. A 0.6 cc sample was taken from each animal, although only 0.4 cc was needed for the analysis. Immediately after it was drawn from the animal, the blood was ejected from the hypodermic syringe into a test tube containing 100 mg of chemically pure potassium oxalate to prevent coagulation.

This technique introduces one possible source of error: that of the nembutal affecting the blood sugar concentration. Some authors do report that hyperglycemia is produced by nembutal in animals fed on a diet rich in carbohydrates. This is supposedly due to the fact that nembutal delays the storage of glucose in the liver as glycogen. According to Sollmann (1937), who quotes the actual references on the subject, nembutal produces no change on blood sugar in an animal which is fasting, or which has been kept on a carbohydrate-free diet beforehand. Squirrels used in this study were starved for forty-eight hours before the samples were taken.

Method of Analysis.—Somogyi's modification of the Shafer-Hartmann method

was used to determine the amount of reducing sugars in the blood (for description of this analytical method see Hawk and Bergeim, 1937). This method was chosen because it requires only a very small blood sample (0.2 cc) and because it eliminates other reducing substances in the blood.

Technique employed in inducing hibernation and obtaining blood from hibernating animals.—Not less than ten days after the initial blood sugar determination had been made on an active squirrel, the animal was put in an electric refrigerator

TABLE 1.—*Average blood sugar concentrations of twenty-one squirrels before and during hibernation*

(Figures represent mg of d-glucose per 100 cc of blood)

SQUIRREL NO.	BEFORE HIBERNATION	DURING HIBERNATION	DECREASE
1	79.0	66.7	12.3
2	89.0	81.4	7.6
3	95.9	87.9	8.0
4	91.4	75.0	16.4
5	99.8	68.2	30.6
6	110.0	62.9	47.2
7	84.9	69.6	15.3
8	82.9	79.2	3.7
9	85.9	62.8	23.1
10	82.8	Did not hibernate	——
11	80.8	59.4	21.4
12	94.0	68.1	25.9
13	76.2	71.8	4.4
14	85.4	Dead	
15	67.1	33.4	33.7
16	81.3	74.1	7.2
17	66.5	72.9	6.4[1]
18	88.1	66.6	21.5
19	75.8	56.4	19.4
20	88.1	80.4	7.7
21	68.2	65.0	3.2
Average	85.3	67.4	17.9
Standard deviation	10.3	11.3	
Probable error	1.1	1.2	

[1] Increase.

set at 6° C. In the refrigerator each squirrel was confined in a one gallon cylindrical tin container nearly filled with cotton waste to serve as nesting material. The tops of the containers were closed with one-half inch wire screen. All light was excluded from the hibernating chamber and ventilation was secured only by opening the refrigerator door for a few seconds every twenty-four hours.

Within a day or two after a squirrel went into hibernation, a blood sample was taken and a sugar analysis made. It was much easier to strike the heart of a torpid squirrel than that of an anaesthetized, non-hibernating animal because of the congestion in the thorax which accompanies hibernation. Usually a

hibernating squirrel made feeble protesting movements when the needle was inserted. Sometimes, however, when hibernation was very deep, absolutely no response of any kind was made when the heart was penetrated. Immediately after the blood was removed, the animal was transferred to a cage in a warm room where it soon became active. At least ten days were allowed for recovery before such a squirrel was used for further experimentation.

Results.—Thirty-three determinations were made on active and 28 on hibernating animals. Each analysis was made in duplicate.

When two blood samples were taken several weeks apart on the same active or hibernating squirrel, a considerable variation in blood sugar concentration was found.

TABLE 2.—*Variation in blood sugar concentration in the same animal when two measurements were made on two different occasions*

(The second determination was made several weeks after the first. All figures represent mg of d-glucose per 100 cc of blood.)

SQUIRREL NO.	ACTIVE			HIBERNATING		
	1st determination	2nd determination	Difference	1st determination	2nd determination	Difference
1	75.8	82.2	6.4	75.2	58.3	16.9
4	112.5	70.4	42.1	54.8	61.2	6.4
5	98.2	99.4	1.2	75.0	61.4	13.6
6	119.0	101.2	17.8	69.9	56.2	13.4
7	75.4	94.3	18.9			
8	94.3	75.4	18.9	65.6	92.8	27.2
8 (repeat)	75.4	79.1	3.7			
9	80.6	91.1	10.5			
10	64.8	100.8	36.0	Did not hibernate		
11				56.0	62.8	6.8
12				69.6	66.5	3.1
13	67.4	85.0	17.6			
16	76.8	85.8	11.0	73.4	74.7	1.3
19	80.4	95.8	15.4	69.2	64.0	5.2
Average			16.7			10.4

A dose of d-glucose was determined, which, when injected intraperitoneally in a hibernating squirrel, raised the blood sugar concentration to that characteristic of an active animal. A dose of 0.5 cc of isotonic dextrose solution raised the average blood sugar concentration in six hibernating squirrels from 69.1 mg per 100 cc to 85.4 mg per 100 cc. When given to 20 hibernating squirrels, this quantity of d-glucose woke 30 percent of them within nine hours. An equal volume of normal saline, given as a control to 13 squirrels woke 30.8 percent of them in the same length of time. The liquids were cooled to the body temperature of the hibernating animals before the injections were made. Squirrels were then observed for signs of waking at one hour intervals for nine hours. A rise in body temperature sufficient to make the animals warm to the touch was adopted as the criterion of waking from hibernation.

Since larger doses of d-glucose could not be given as isotonic solutions because of the volume of liquid required, the use of a hypertonic solution was adopted. Accordingly, a dose of 0.5 cc of saturated d-glucose solution was given to 33 squirrels. This woke 66.7 percent of them. Possibly the difference in the osmotic pressure of the solution and that of the animals' body fluids was responsible for waking a larger percentage of squirrels. It was not considered possible to devise a valid control experiment to check this point. Any hypertonic solution that might be used as a control would have the specific chemical effect of its solute in addition to the purely physical effect of increased osmotic pressure. In spite of this, these results show that even large doses of d-glucose do not wake squirrels infallibly.

No difference in the behavior of the two sexes was noted in any of the experiments.

SUMMARY AND CONCLUSIONS

(1) A wide individual variation in blood sugar concentration exists in active spermophiles. The lowest recorded was 64.8 mg glucose per 100 cc, the highest, 119 mg, with an average of 85.3 mg. These figures are somewhat lower than those found in the literature. There are several possible explanations for this: (a) the analytical technique used in these experiments eliminates a number of other reducing substances in the blood that the usual colorimetric methods do not; (b) squirrels were anaesthetized before samples of blood were drawn to avoid hypoglycemia caused by the animals' struggles; (c) analyses were made on fasting animals only; (d) squirrels were left hibernating not longer than 48 hours before analyses were made; (e) the literature concerns species other than *Citellus tridecemlineatus*.

(2) There is also a wide individual variation in blood sugar concentration in hibernating squirrels. The lowest was 33.4 mg, the highest, 92.8 mg, with an average of 67.4 mg.

(3) The blood sugar concentration in the same active animal is subject to great variations at different times. When two blood sugar determinations were made several weeks apart on the same active squirrels, an average difference of 16.7 mg per 100 cc was noted in the 12 animals used in this experiment.

(4) Less variation in blood sugar concentration in the same hibernating squirrel was noted. An average difference (for nine squirrels) of 9.3 mg per 100 cc was found when two determinations, several weeks apart, were made on the same individuals.

(5) The blood sugar level during hibernation does not commonly fall to, or below, the convulsive level, if we assume the convulsive level, like that of other mammals, is 45 mg per 100 cc. Only one exception was noted. Here the blood sugar concentration during hibernation fell to 33.4 mg per 100 cc, but, when the same squirrel was active, it was only 67.1 mg. The average level during hibernation for all the squirrels was 22.4 mg per 100 cc above the supposed convulsive level. There is nothing to indicate that the blood sugar concentration commonly falls to that characteristic of an animal in "insulin hibernation."

(6) Some squirrels are very resistant to hibernation and others pass into the torpid state quite readily. It has been suggested (Johnson, 1931) that animals very resistant to hibernation may have an abnormally high blood sugar concentration. In this study one squirrel was found which did not hibernate after having been in the cold chamber 30 days. At the beginning of this period its blood sugar concentration was 64.8 mg per 100 cc and at the end of the 30 days it was 100.8 mg per 100 cc. Of course, experimental results from one animal can establish nothing, but they suggest that the blood sugar concentration was not solely responsible for his individual's resistance to hibernation. This animal's ability to withstand hunger and thirst during this 30 day period seems quite remarkable in itself. At the end of the period of privation, the squirrel appeared as active and healthy as before.

(7) All evidence presented here indicates that, although a small diminution in blood sugar accompanies hibernation, it is not essential to the maintenance of the torpid condition. This statement is supported by the following facts: (a) Some hibernating squirrels were found with higher blood sugar concentrations than those that were active. Likewise, some active squirrels had lower blood sugars than others that were hibernating. (b) In one case only, an increase in blood sugar was noted during hibernation. This, however, may have been due to an error in analysis. (c) By means of injections of d-glucose, the average blood sugar concentration of hibernating squirrels was raised to that characteristic of active animals without causing a higher percentage of waking than did equal doses of normal saline. (d) Much larger doses of d-glucose given as hypertonic solutions did not wake squirrels reliably.

The writer is indebted for many considerations to Dr. Otis Wade of the Department of Zoology of the University of Nebraska under whose immediate supervision this work was done.

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NOTES ON A SUMMER COLONY OF *MYOTIS LUCIFUGUS LUCIFUGUS*

BY FRED R. CAGLE AND LENDELL COCKRUM

A large colony of *Myotis lucifugus lucifugus* has occupied the attic of the Main Building on the campus of the Southern Illinois Normal University for the past 50 years. In July 1939, an unsuccessful attempt to eliminate the bats resulted in the death of several hundred. Data compiled from these collections emphasized the opportunities for investigation presented by the colony and a long term research program was planned. This paper is a report of the preliminary researches.

We are indebted to Dr. Mary J. Guthrie, University of Missouri for suggestions and to Dr. Wilfred Osgood, Field Museum of Natural History, and Dr. William H. Burt, Museum of Zoology, University of Michigan, for aid in making identifications. Dr. Norman Hartweg, Museum of Zoology, University of Michigan, has made manuscript suggestions for which we are grateful.

Previous to 1933, most of our knowledge of this species was represented only by isolated notes distributed through the literature of vertebrate zoology. Guthrie (1933a, 1933b), Guthrie and Jeffers (1938), Hartman (1933), and Miller (1939) have added substantially to the knowledge of the reproductive cycle and of seasonal movements. Mohr (1933, 1936), Poole (1932), Griffin (1936, 1940a, 1940b), and Hitchcock and Reynolds (1942) have contributed much to the knowledge of breeding habits, diurnal and seasonal movements, and migration. Many workers have made contributions to the bionomics of other species from which we may venture to assume facts about *Myotis lucifugus lucifugus*.

The colony is established each summer in the attic of the Main Building on the college campus (Plate 1, upper). This building, constructed in 1887, has a

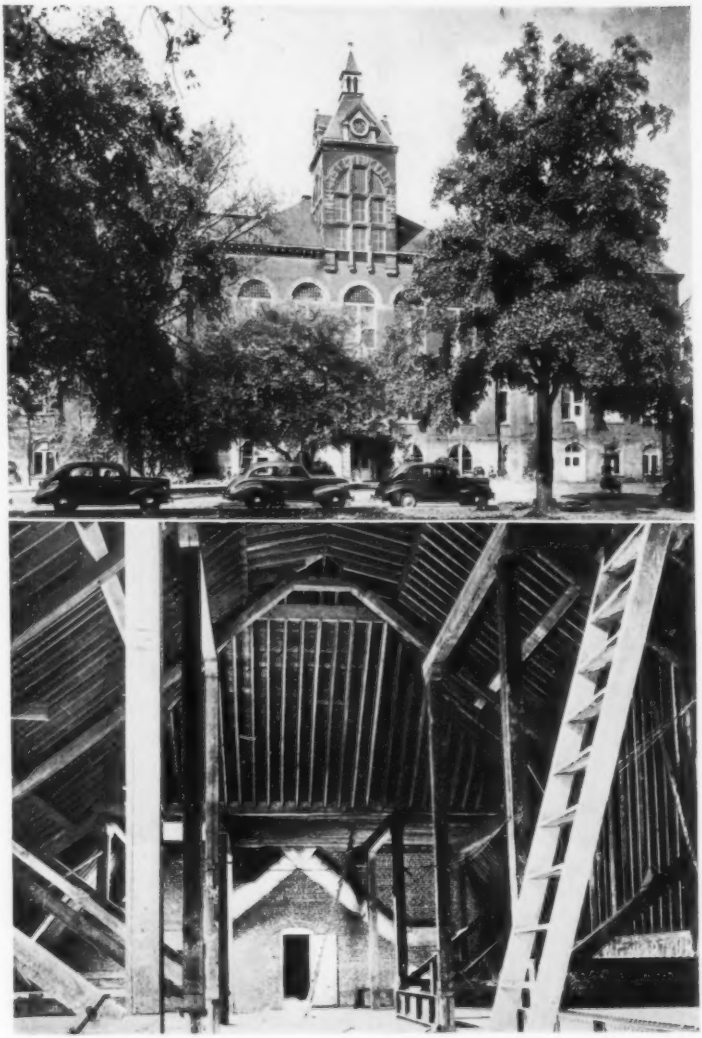

PLATE 1

UPPER: The Main Building on the campus of the Southern Illinois Normal University. The tower and attic is the home of the summer colony.

LOWER: The interior of the attic. The bats find their resting places between the thick pine beams supplying the roof and in every dark crevice available.

high, angled roof, supported by large, close set pine beams forming an attic offering almost ideal quarters for a bat colony (Plate 1, lower). The construction of stairwells at either end of the attic resulted in the closing off of two small, lightless rooms in which the bats tended to aggregate (fig. 1). Outside of these rooms they favored dark, narrow crevices between the highest roof beams. The attic has been closed for many years except to an occasional visitor and a janitor who annually removes the accumulation of guano.

METHODS

Bats examined during 1939 were collected by knocking them from crevices with the aid of long poles tipped with wires. This, although a simple and ef-

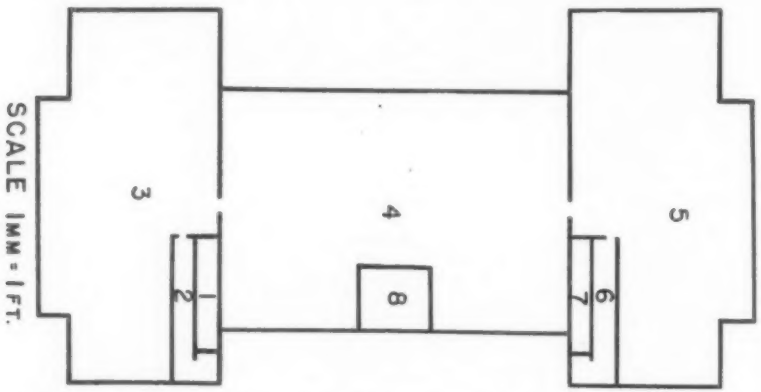

FIG. 1. Floor plan of the attic. Nos. 2, 6 are stairways leading into the attic; nos. 1, 7 are small dark rooms above the stairs; no. 8 is a tower; nos. 3, 4, 5 are large, rather well lighted rooms.

fective method of obtaining them, resulted in the death of all bats taken and thus reduced the population considerably.

In 1939, weights accurate to a decigram were taken and observations of data on reproduction recorded.

In the summer of 1940, a variety of collecting methods were employed in an attempt to obtain large numbers of individuals for banding. In the two rooms described, bats could be picked from the wall by hand but this method soon caused them to seek crevices high in the attic.

Trapping as described by Griffin (1940a) was attempted, but with little success as the attic was large and had many available exits. A modification of his trapping method yielded satisfactory results. When a crevice containing bats was located, all exits were covered with cheese cloth except one that led to the collector's bottle into which the bats were then driven.

The third and most successful method employed a pair of long forceps in the hands of a skilled collector. With such equipment bats can be pulled gently from

their places of concealment and dropped into a collecting can. This method, when carelessly used, may result in some injury to the bats.

Samples from the colony were taken at rather regular intervals. The bats were collected as described, placed in containers and removed to the museum laboratory in an adjacent building where their sex, weight, forearm measurement, and notes on pregnancy were recorded with any other observations of probable significance. A small sample of females was retained from each collection for examination; the remainder were banded with bird bands provided by the U. S. Fish and Wildlife Service and released in anticipation that some would be recovered for data on movements and growth.

SUMMARY OF OBSERVATIONS

1939

A summary of the collections made in 1939 is presented in Figure 2. These graphs do not accurately represent authentic samples of the normal population

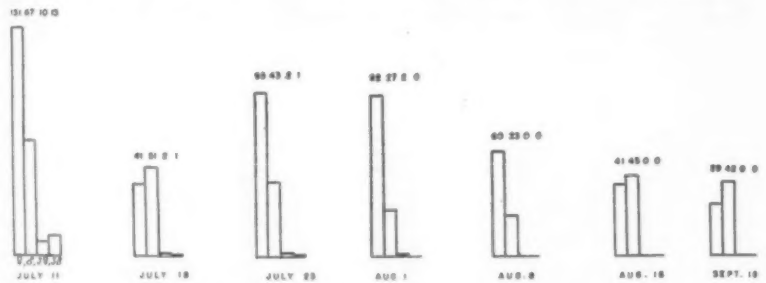

FIG. 2. Composition of collections of *Myotis l. lucifugus* made in 1939. Juveniles separated from adults solely on the basis of weight; thus only those specimens weighing less than 6.0 grams were called juveniles.

on the dates indicated as all bats were killed on the date collected. Unfortunately, no differentiation was made between adults and juveniles at the time of examination and it was necessary to separate juveniles from adults on a weight basis. Those weighing less than six grams were designated as young of the season. This separation is not wholly accurate and these histograms can not be compared with those for 1940. Thus, juveniles were doubtless present during August but only two individuals were found with weights less than six grams.

The first collection, made on July 11, contained only one pregnant female that weighed 9.9 grams and contained an embryo weighing 1.3 grams. All other females had either already given birth to young or had not been pregnant that season. Four of 23 juveniles were only a few hours old and weighed 2.5, 3.0, 3.1, and 2.7 grams respectively. No pregnant females or very young bats were observed in collections made after July 11.

The weights of all specimens taken during the summer are presented in Figure 5.

1940

April.—Bats were first observed in the attic on April 1 when 8 females were collected from a group of approximately 40 bats, the only ones present. On April 2, 8 additional females were collected. These 16 females ranged in weight from 5.9 to 8.6 grams; mean, 6.85 grams. No males were observed in the attic on these dates.

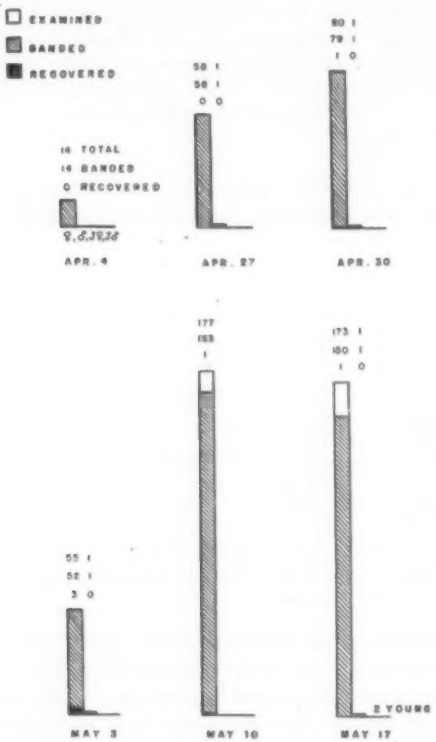

FIG. 3. Collections of *Myotis l. lucifugus* made April to May, 1940.

The slightly enlarged uteri of these females indicate that they were in early stages of pregnancy. Complete reproductive systems of several were retained for sectioning, but there has been no opportunity to complete this phase of the work.

Although few bats were present during this first week in April, they were abundant during the latter part of the month. The majority of the females taken April 27 and April 30 were pregnant.

May.—Collections made May 3, 10, 17–18, and 31 yielded 600 adult females, 4 adult males, 7 juvenile females and 6 juvenile males (figs. 3, 4). Eleven fe-

males, examined May 10–16, had a mean weight of 6.9 grams. They contained eight embryos having a mean weight of 0.40 grams. Of 18 females having a mean weight of 7.0 grams examined May 17–18, 15 contained embryos with a mean weight of 0.45 grams (Table 1; fig. 7, lower).

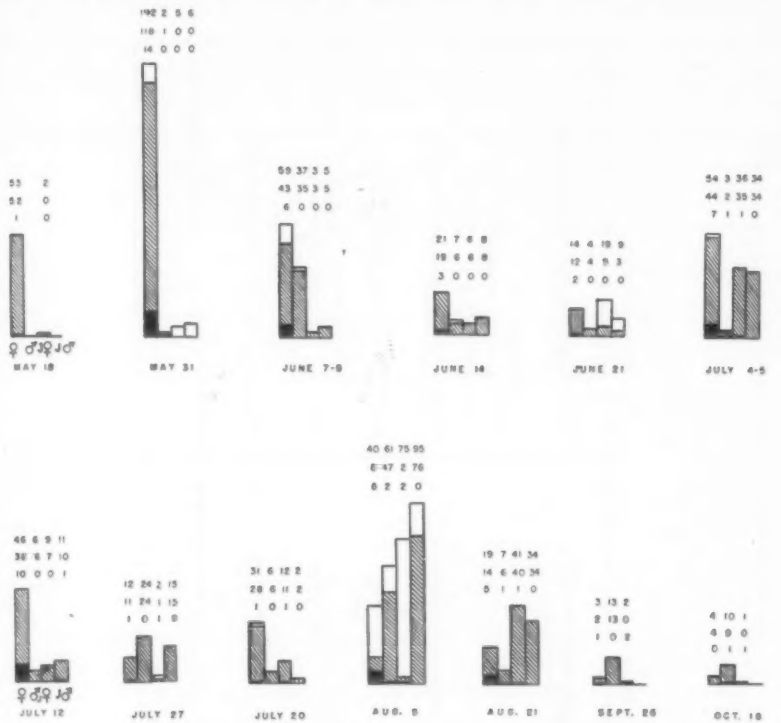

FIG. 4. Composition of collections of *Myotis l. lucifugus* made from May 18 to October 18, 1940.

Palpation suggested that less than 3 percent of the females collected prior to May 18 were not pregnant. This 3 percent may have been in such early stages of pregnancy that it could not be determined by this method.

Two recently born young, found in the bottom of a collecting jar May 18, weighed 2.8 and 2.0 grams, respectively.

While several pregnant females were being banded on May 18, parturition occurred in one female. When first observed the young had completely emerged and the female was attempting to remove the umbilical cord from the vagina. When moved to a better place for observation, she took flight with the young bat dangling from the umbilical cord. She experienced some difficulty in flight. Sherman (1930, p. 503) observed a like occurrence in *Myotis austroriparius*.

Another female had been placed in a glass-bottomed jar where her activities could easily be observed. When found, the young had just been born and the umbilical cord was still within the vagina except for about 3 mm. The young bat clambered under the wing of the female and snuggled against her body with its wings folded tightly around itself while the mother raised her head and trem-

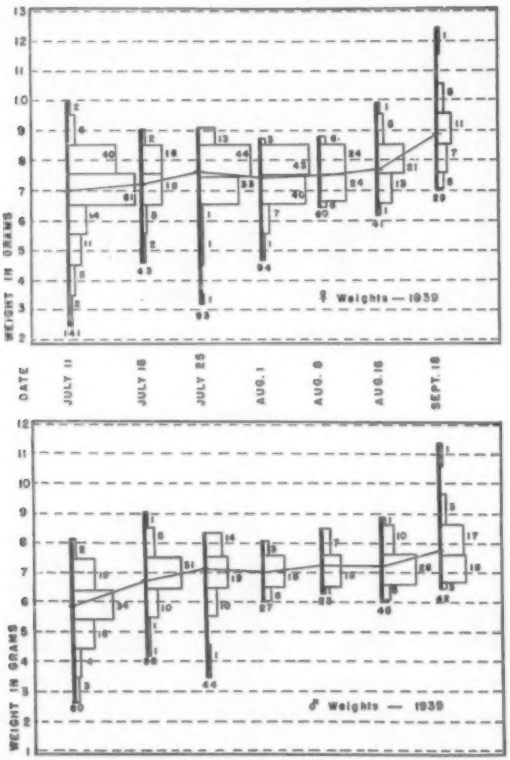

FIG. 5. RIGHT: Weight frequencies for females (adult and immature) of each week's collection in 1939. LEFT: Weight frequencies for males (adult and immature) of each week's collection in 1939. Curves are based on mean weights.

bled violently for several seconds. She then attacked the short strip of umbilical cord with her teeth while the young bat attached itself to the left teat. The female continued to work at the umbilical cord for about five minutes, pulling it from the vagina with short, upward movements of the head. Finally it was all removed and a large portion of it and the placenta were eaten. Sherman (*op. cit.*, p. 502) states that in the normal birth of the young of *Myotis austroriparius* the placenta did not appear until several hours after birth when it was

pulled out by the teeth of the mother and eaten. Mohr (1933, p. 52) points out that in two observed cases of parturition in *Myotis lucifugus* the umbilical cord was not severed but remained attached to the placenta, which dried and apparently broke off from the umbilicus on the second day.

Of a total of 11 young bats found on May 31 (fig. 4), five were dead on the floor of the north attic room and six others were found in the bottom of a collecting jar. These latter were probably attached to the females but were separated by the roughness of the collecting method. The weights of the young

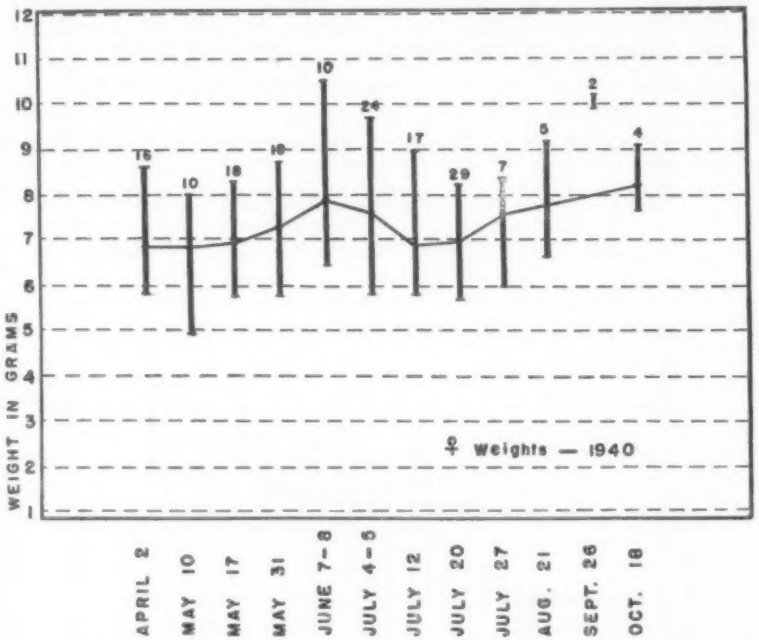

FIG. 6. Weights of adult females of each collection made in 1940. Curve based on mean weight of each collection.

females were 2.5, 3.8, 3.5, 3.4, and 2.8 grams; weights of males, 3.6, 2.7, 4.3, 3.5, 4.1, and 2.3 grams. Of the 142 adult females collected May 31, the majority were pregnant or had already given birth to young (Table 1).

June 7–8.—This collection was unusual in that 38 percent of the adults collected were males. Many of the females contained large embryos and some had already given birth to young (Table 1).

One banded female had been released May 31, 1940. When examined on that date she was observed to be in a late stage of pregnancy and when recovered June 7 carried a young bat that, obviously several days old, weighed 3.4 grams. When removed from the female, weighed and returned, the young immediately

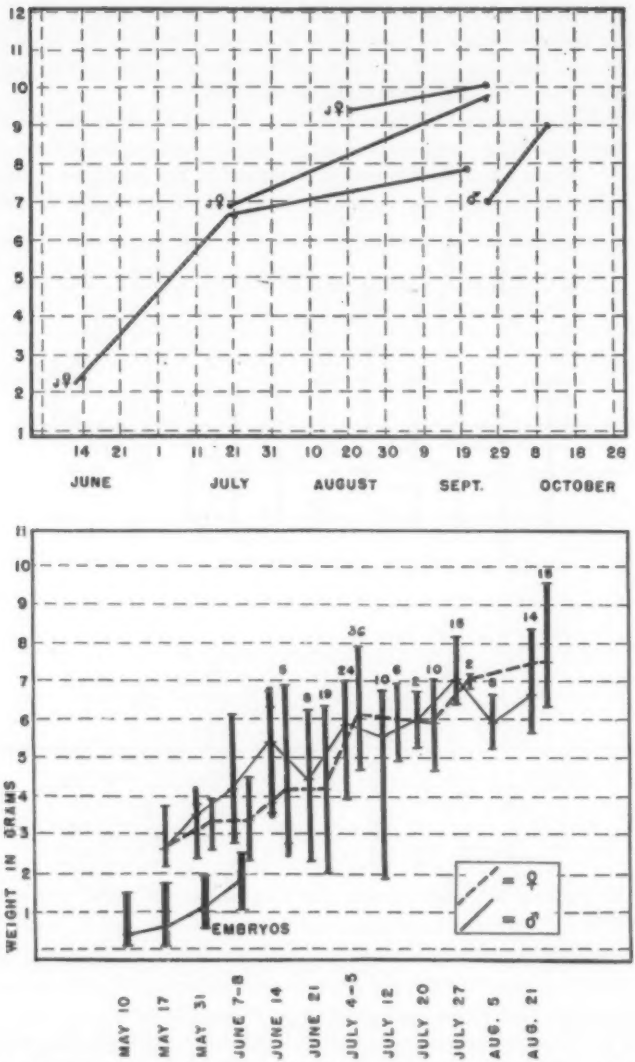

FIG. 7. UPPER: Growth of specimens banded and recovered on the dates indicated. Thus one Juvenile female collected June 14 weighed 2.4 grams; recovered July 21, she weighed 6.7 grams; recovered again in September, she weighed 7.9 grams. LOWER. Increase in mean weight of embryos examined in 1940.

reattached itself. This recovery clearly indicates that the females can fly successfully even in the latest stages of pregnancy and demonstrates the rapid growth of the young.

Another female had a young weighing 3.2 grams attached to the left teat. A young female found isolated from any adult weighed 4.4 grams.

A male weighing 6.0 grams was unable to fly but fluttered from table to floor. When placed on a lactating female, it immediately attached itself to a teat. Another young male, unable to fly, weighed 5.5 grams. Three other young males weighed 4.4, 2.7, and 3.4 grams respectively.

June 14.—Of the 21 adult females in this collection, 7 contained large embryos; 3 had young attached and the remainder were without young or embryos. One female, weighing 6.9 grams and with a forearm length of 37.3 mm, carried a young male weighing 5.9 grams with a forearm length of 35.0 mm. When released with the juvenile attached to her teat, she fluttered to the ground on the first two attempts at flight but on the third flew to a tree 100 feet away. The young male could not fly and was dependent upon the female for sustenance.

One juvenile male weighing 6.8 grams, with a forearm length of 36.4 mm, flew readily when released. This specimen was only 0.9 grams heavier than the dependent male described above.

TABLE 1.—*The weights of females and embryos examined May 10–June 8*

DATE	FEMALES			EMBRYOS		
	No.	Weight range grams	Weight mean grams	No.	Weight range grams	Weight mean grams
May 10–16	11	5.0– 8.0	6.9	8	0.02–1.62	0.40
May 17–18	18	5.8– 8.3	7.0	15	0.02–1.73	0.45
May 31	10	5.8– 8.7	7.3	6	0.62–1.85	1.13
June 7–8	5	6.5–10.5	8.3	3	1.00–2.30	1.80

June 21.—The colony had apparently decreased in numbers, as bats were not present in the usual places and some difficulty was encountered in making a collection.

Of the 14 adult females collected 3 were in late stages of pregnancy and the others had given birth to young. One pregnant female, banded June 14 and recovered June 21, had given birth but no young was attached. Eight young bats were collected as they crawled about on the brick walls. This movement of the young, noted several times, results in considerable parental confusion and juvenile mortality. The smallest male able to fly weighed 5.9 grams; smallest female, 5.0 grams.

July 4–5.—The bats of this collection were in poor physical condition; many had large patches of hair gone and one was almost completely denuded. External parasites had increased sharply in abundance. The temperature of the attic had been unusually high this week (over 100° F. at time collection was made).

Two of the females collected contained large embryos and the others carried young. Numerous young bats were collected as they crawled about the walls and floors.

July 12.—Five of the adult males in this collection were isolated from each other and from the females. One male was found with the group of females.

Of the 46 adult females one contained a large embryo and two had young attached.

July 20.—Of the 31 adult females collected none was pregnant and none was carrying young. No very young bats were observed in the attic.

July 27.—The histogram of this collection represents some inaccuracy as all juveniles could not be accurately separated from adults.

August 5.—The juveniles and adults of this collection were separated, on the basis of the amount of wear on the teeth, by Dr. Mary Guthrie and her assistant.

August 21.—This collection was made from crevices in one of the highest points of the attic. All the specimens were in poor physical condition and many appeared to be in a stupor. The temperature of their resting place exceeded 100° F.

September 26–November 10.—During this period the population of the colony decreased rapidly. In a thorough search on November 10, only five bats were observed.

REPRODUCTION

The reproductive habits of *Myotis l. lucifugus* are in general comparatively well known. It has been well demonstrated that copulation occurs in the autumn; males remain sexually active throughout the winter; that copulation may occur again in the spring; that females found in hibernation may or may not have sperm in the vagina and that ovulation occurs when the females leave hibernation (Hahn, 1908; Miller, 1939; Guthrie, 1933b; Hartman, 1933). Deanesly and Warwick (1939, p. 58) point out, "The inception of pregnancy in the bat cannot be accurately dated in the usual way, since the egg is fertilized in the absence of the male. Reliable information about the length of gestation is only to be obtained by the collection of samples from a colony during the breeding season and the examination of the progress of pregnancy in a large series of animals under natural conditions." This suggested method was adopted in the study of this colony. Females were collected at regular intervals, examined for pregnancy, and a small sample from each collection killed to secure embryo measurements. Data thus obtained are listed in the previous section and graphically presented in Figure 7.

The first females obtained, April 1–11, were all apparently in early stages of pregnancy and the next group, collected May 10, exhibited a wide range in size and weight of embryos. In two specimens the uterus was only slightly enlarged and the embryos minute. Those embryos measured ranged in length from 4 to 16 mm, and in weight from 0.02 to 1.62 grams. A similar wide range is indicated by embryo measurements recorded May 17, May 31, and June 7 and by the long period over which young were born. The first was born May 17; the last, July 12.

This range in birth dates is somewhat greater than that observed by Griffin (1940b, p. 182) who found new born young from June 13 to July 14. He suggests that the older females may, as a result of fall copulation, begin their gestation

sooner and thus give birth to young in June; young females, forced to wait for spring insemination, begin gestation later and their young are not born until the middle of July.

Guthrie (1933b) who examined bats taken from caves during winter observed that a single young female examined October 28 carried abundant sperm. In a series examined in March she could discern no difference in young and old in contents of vaginal material or stage of gestation. Further, Guthrie (1933a), in her studies of the movements of cave populations of *Myotis l. lucifugus*, observed on February 28 that the bats were active and that the young bats were more numerous near the entrance. Most of the last bats collected in the caves April 16 were old. Thus the young bats leave the cave first.

Eisentraut (1936) suggests that the variation in the time of birth is a result of the delay of some females in leaving the hibernating quarters. In view of Guthrie's observations this appears to be the most likely explanation of the range in birth dates.

This period of 56 days (May 17–July 12) corresponds closely with field observations of bats both moving from winter quarters and arriving at summer colonies. Guthrie (*loc. cit.*) observed that in the Missouri caves there was a movement to the entrance on February 28 and that the last bats were observed on April 16. This covers a period of 47 days.

Observations in Illinois indicate that females slowly filter from the winter quarters. This is further emphasized by the continual arrival of additional females at the summer colony until the peak of the population was attained in mid-May.

This wide range in parturition dates is in decided contrast to the situation in *Eptesicus f. fuscus* and *Nycticeius humeralis*. Gates (1941) reports almost simultaneous parturition in a colony of *Eptesicus* in which 11 females gave birth to young within 30 hours. He points out that all females of *Nycticeius*, in any one colony, apparently ovulate in the spring within a relatively few days or perhaps hours of each other.

The peak of parturition was reached during the last week of May and the first week of June. This is indicated by various data. On May 31 the smallest embryo of six examined weighed 0.62 grams and measured 13 mm in length. Of the 142 females examined on that date, most had given birth and, of 10 females selected at random for dissection, only 6 were pregnant (Table 1). Eleven recently born young were collected and many more observed in inaccessible crevices. That most of the young are born during this period is further indicated by the fact that the mean weight of the females reached the highest summer peak in the collection of June 7 (fig. 6).

The actual birth of the young of *Myotis lucifugus* was not observed, but on May 18 two females were studied immediately after parturition had occurred. The weight of one of these females was 7.0 grams, the weight of the young 2.3 grams. Two young bats (apparently newly born), found May 17–18, weighed 2.8 grams and 2.0 grams, respectively.

The young bats attach to the teats of the female immediately after birth.

The female flies readily with the newly born young but becomes progressively awkward as the weight of the young increases. It is probable that females carry the young on feeding flights until they become excessively heavy and then leave them at the colony.

There has been much discussion in the literature relative to sex ratios in bats. Possibly much of this has arisen as a result of the attempt to discuss ratios on the basis of comparatively small numbers of individuals. Interesting comparisons of sex ratios in the young bats on consecutive collections may be made (fig. 4). On June 21, of 28 juveniles the sex ratio was 19 females: 9 males; July 4–5, 36:34; August 5, 75:95; August 21, 41:34. Workers visiting the colony on these dates might have drawn some interestingly different conclusions relative to the sex ratio. The total number of juveniles examined from the colony was 432, 213 females and 219 males. This nearly 1:1 ratio is similar to that found

TABLE 2.—*Growth of bats as determined by release-recovery procedure*

NO.	SEX	DATE COLL.	WEIGHTS GRAMS	LENGTH OF FOREARM MM.
92822	j ♀	June 14, '40	2.4	15.9
		July 20, '40	6.7	35.5
		Sept. 20, '40	7.9	35.8
78130	j ♀	July 20, '40	6.9	37.5
		Sept. 26, '40	9.7	37.8
78332	j ♀	Aug. 21, '40	9.4	37.3
		Sept. 26, '40	10.0	37.0
78419	♂	Sept. 26, '40	7.0	35.4
		Oct. 10, '40	8.9	35.4

by Griffin (1940b) who examined 890 juveniles in a summer colony and found that 450 were males and 440 females.

GROWTH

There is little information available on growth in *Myotis l. lucifugus*. In an endeavor to secure such data bats banded and released were weighed and the forearms measured. During the summer of 1940 four recoveries were made (Table 2).

Bat no. 92822 was only a few hours old when removed from the female, banded, and subsequently released on the floor of the attic on June 14 (fig. 7). Although very young and feeble the bat must have made its way to a lactating female willing to adopt it. Four weeks later it had attained adult weight and in an additional five weeks gained 1.2 grams. Furthermore, this rapid increase in weight was paralleled by an increase in the size of the forearm.

It is of interest to note (fig. 7) that by mid-September these three juvenile females had reached the respective weights of 7.9, 9.7, 10.0 grams, a mean weight

of 9.2 grams, 1.7 grams greater than the mean weight of 15 juvenile females examined August 21 (see fig. 7); further, that the mean weight of these three females is 0.4 grams greater than the mean weight of 29 females (both juveniles and adults) collected on September 18 (fig. 5). The mean forearm length of these three bats was 36.8 mm as compared with the mean forearm length of 35.9 mm of 7 juvenile females examined on August 21. Thus it is apparent that the juvenile females attain full adult weight and forearm length during the first summer of growth.

This is reemphasized by a comparison of the lower graph of fig. 7 with the lower section of fig. 5. The mean weight of 15 juvenile females (fig. 7) examined August 21 was 7.5 grams; the mean weight of 41 females (fig. 5) (including both juveniles and adults) examined August 16 was 7.7 grams.

These three juvenile females had reached a mean weight of 2.4 grams more than the mean weight of 16 adult females collected in the colony April 2 (fig. 6). As the juveniles would probably continue to increase in weight (note the single male on which weight increase was known, fig. 7), there is obviously a substantial loss of weight during the period spent away from the colony from September to April. This is further indicated in Figure 6. The mean weight of 16 adult females collected April 2, 1940, was 6.8 grams; mean weight of 4 adult females examined October 18, 1940, was 8.2 grams, a difference of 1.4 grams.

The bats prepare for this loss of weight during hibernation by a gradual but definite increase in weight during the summer. The rapidity of weight increase is indicated in Figures 5, 6, and 7. The entire population assumes a high mean prehibernation weight. The rapidity of weight increase in the three juvenile females is similar (fig. 7). The single male studied showed a rapid increase without a corresponding increase in the length of the forearm. Perhaps it is of significance that this male was released from September 26 to October 10, a portion of a period in which the mean weight of both males and females increased rapidly (figs. 5 and 6) and in which bats moved away from the colony (figs. 2 and 4).

Allen (1921, p. 57), who studied a colony of *Myotis lucifugus lucifugus* in Homer, N. Y., July 5, 1907, states that there appeared to be three distinct sizes of young differing in average size, amount of hair, and color. At no time could the young bats of the Carbondale colony be divided into such distinct groups. Parturition occurred over a period of 56 days and it was not possible to group the young.

On two occasions females were collected in flight carrying recently born young. In most of the collections during June and July young bats were found both attached to females and free.

It was not possible to determine the presence of young bats in the absence of the adults as there was no period observed during any night when all the adults were away from the attic, but many young bats were found isolated from females. Griffin (1940b, p. 182) points out that the female *Myotis lucifugus* usually carries the young as she hunts during the first three or four days after birth, but when older they are left in the roost.

As the young bats move rather freely about the crevices and as large numbers are present, it is probable that the female does not always find her own young but adopts the one most convenient. Lactating females readily accepted young bats from other females. No. 92822, separated from its mother, banded, and released when only a few hours old, was subsequently recovered twice.

The first young bat able to fly, collected June 14, weighed 6.8 grams and had a forearm length of 36.4 mm (Table 3). A dependent young male weighing 5.9 grams with a forearm length of 35 mm was collected on the same date. Two young weighing 6.0 and 5.5 grams collected June 7–8 could not fly. Assuming that growth in young bats is rather uniform, the independent young male was about 35 days old when it first became capable of flying (fig. 7). On June 21 the smallest male able to fly weighed 5.9 grams; the smallest female, 5.0 grams. Griffin (1940b, p. 183) states that apparently the young of *Myotis lucifugus* learn to fly when three weeks to a month old.

TABLE 3.—*The weights and forearm measurements of twelve juveniles collected June 14*

Sex	♂	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
Weight, grams	3.4	4.7	5.3	5.7	5.9	6.0	6.2	2.7	3.3	3.4	5.0	6.8
Length of Forearm, mm	20.0	24.5	29.9	30.8	31.0	36.6	34.2	15.9	18.5	20.5	27.3	36.4

THE COLONY

During 1940, the first bats were observed in the attic on April 1, when a group of 40 was present. No bats were observed March 28, when a careful check had been made. The females filtered into the colony until mid-May when the maximum adult female population was present. A few adult males were always present in the colony (figs. 3 and 4) but the majority of them did not return until the first week of June (fig. 4). Eisentraut (1935) states that in *Myotis myotis* the sexes are promiscuously mixed in winter quarters but that the males and females are separated for at least the first half of the warm season. Griffin (1940b, p. 182) states of the summer colonies of *Myotis l. lucifugus*, "On rare occasions an adult male may be taken, usually very early or late in the summer. There are also a few non-breeding adult females in most large breeding colonies of little brown bats."

Meager evidence was obtained as to the activities of the male during the first half of the summer, but data presented by workers in other areas suggest that they remain in the caves longer than the females and lead solitary lives until they enter the colonies in mid-summer. Hahn (1908, p. 162) states of bats observed in caves near Mitchell, Indiana, "The females leave the caves somewhat earlier than the males. On April 25, 1908, in a search through the outer parts of all the caves on Cave Farm I found 23 male *P. subflavus* and 4 females. Twenty-five male *M. lucifugus* were also found to 2 females of that species. On May 13, in Truitts Cave there were seventeen *P. subflavus* and 5 *M. lucifugus* all of both species being males."

Sherman (1929) made observations on bats flying or seeking shelter about the windows of her home in Minnesota. Referring to her observations over a fourteen years period she states (*op. cit.*, p. 322) that many of the window lodgers were males and that an increase in bat numbers in late July and August was due to the presence of females that came out seeking mates.

After the males entered the colony they tended to remain isolated from the females, but they occasionally mixed with them. Deanesly and Warwick (1939) describe summer colonies of *Pipistrellus pipistrellus* in Tweed Valley near Clovenfords, Selkirkshire, England. They state (*op. cit.*, p. 58), "... females are virtually segregated from the males during pregnancy; such "nursing colonies" are believed to be common in all British bat species which have been studied, (Barret-Hamilton, 1910; Matthews, 1937) and also in continental species (Duval, 1895; Rollinat and Trouessart, 1896). A few immature males and females may be found in these colonies, but apparently not adult males."

Thus, Deanesly and Warwick reported the absence of adult males from the English and European colonies during the entire summer. This situation is interestingly different from that in the Carbondale colony where the adult males suddenly appear in large numbers in June.

After most of the young were born, the population slowly diminished. The older females apparently left the colony first and by September few bats were present (fig. 4). A few stragglers remained in the attic until the last of October.

The bats changed much in physical condition during the summer. When they first entered the colony they were in good pelage and were active. As summer proceeded, air temperatures rose, the females became encumbered by the weights of the embryos and the level of activity in the colony dropped. After the young were born and the males returned, there was a sudden renewal of activity. By this time (July) the average daily temperature of the attic was very high.

During this period of high temperatures the incidence of external parasites rose abruptly and many of the bats lost much of their hair. Bats frequently found clinging to the walls in a state of semi-stupor reacted like hibernating ones. Bats in a similar condition have been observed by other workers (Griffin, 1940b; Hahn, 1908).

Observations made in 1940 indicate that individual bats did not stay in any one place in the colony. Individuals found in one crevice on a given collection date might be recovered in the same place during subsequent collections but often they were found elsewhere. In most instances other individuals moved into the location vacated. In no instance did a complete group return to the same spot in the attic from which it had been collected. The usual percentage of returns was low. Some specific data were accumulated on the movement of individuals (Table 4).

The many bats banded and recovered in area 7 as indicated were due to extensive collecting in that area on May 17 and 31. High temperatures, birth of young, intrusion of males and molestation during collecting caused much movement of bats within the colony.

During the period of high temperatures the bats moved to lower levels away from the roof. The slate shingles absorbed much heat from the sun's rays and the temperature near the roof was high. On August 5, 1940, the bats had moved to the lowest levels where they were found in cracks in the walls and in crevices around the doors; few were found at the higher levels.

During the time of parturition, females tended to group according to their reproductive phase, thus some groups were composed almost entirely of females in late stages of pregnancy or with recently born young; other groups contained mainly females in early stages of pregnancy or from which the young had departed. On May 31, a group of bats in late stages of pregnancy or with recently born young were noted in a crevice on the north wall of one of the rooms formed by the closing off of the stairwells (area 7 in fig. 1). Subsequent observations

TABLE 4.—*Data on capture and later recovery of thirteen females*

BAND NUMBER	DATE BANDED	AREA IN WHICH BANDED	DATE RECOVERED	AREA IN WHICH RECOVERED[1]
92009	April 4	3	May 31	7
92385	May 17	7	May 31	4
92379	May 17	7	May 31	7
92445	May 17	7	May 31	7
92421	May 17	7	June 7–8	7
92509	May 17	7	May 31	7
92535	May 17	7	May 31	4
92560	May 18	7	May 31	7
92573	May 18	7	May 31	4
92596	May 18	7	May 31	7
92626	May 31	7	June 7–8	2
92654	May 31	7	June 7–8	5
92822	June 14	3	July 20	4
			Sept. 20	3

[1] See Fig. 1.

showed this one crevice to contain bats of the same stage until all of the young were born.

During the early part of June, when the male intrusion was first noted, the males were found to have congregated in area 1 (fig. 1). When the area was checked on May 31, no males were present.

That the disturbance of the bats caused a variation in the position of individuals was evident. Perhaps this was one of the main factors in individual movement in this colony. On June 14, areas that had been molested previously were found deserted whereas areas previously unmolested were crowded. Banded individuals were collected where no previous collections had been taken. On July 4–5, the bats were in almost inaccessible crevices, having moved from the areas in which they had been disturbed.

Observations made on daily movements of the colony differed somewhat from those made by Griffin and Welsh (1937, p. 338) who state: "When they are not hibernating, bats of the genera *Myotia*, *Pipistrellus* and *Eptesicus* spend the day-

time asleep. These bats emerge shortly after sundown and a whole colony of several hundred may leave the roost in a few minutes. Often, if food be plentiful, the bats return to their roost in a couple of hours. There may be a second period of activity in the early morning."

Observations made in the attic roost showed *Myotis* to be present in numbers at all times of the night. The earliest bat in flight was observed about sunset and the latest was seen flying over a small pond after daybreak. The greater number, by far, were observed before 11:00 p.m. although considerable numbers have been observed late in the night.

On July 5, when the colony was examined at 11:30 p.m., many bats were still in the crevices, a few were flying around in the attic, and several were observed feeding outside. Observations on other dates at hours from dusk until 3:00 a.m. indicated that some bats were feeding at all times.

The homing range (distance from which an individual will return to the colony) was not throroughly investigated. One group of 52 bats was taken from the colony on May 3, 1940, however, and released at Vandalia, Illinois, (approximately 100 miles north of the colony). On August 5, 1940, one of these bats was recovered in the Carbondale colony.

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AN UNUSUAL PORCUPINE PARTURITION AND DEVELOPMENT OF THE YOUNG

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Information on the early life history of the Canadian porcupine (*Erethizon d. dorsatum*) is very meagre, and rearing of these animals to obtain detailed information on breeding, gestation period, and early postembryonic development has been greatly neglected. At the present time (April 1942) there are in the files of the United States Fish and Wildlife Service only two records of the *breeding and birth in captivity* of the Canadian porcupine. The first case was reported by Struthers (1928) and the second occurred at the Biology Laboratory at the University of Buffalo, July 22, 1941.

PARTURITION AND POSTPARTURITION

In the summer of 1940, four porcupines were brought into the vivarium at the University of Buffalo and were used in a study of extrusive growth and attrition of the incisors (Shadle 1936). Occasional indications of mating were noted but no definite periods of rut were observed in the late fall and early winter. In April, the female was believed to be pregnant but she later began to lose weight so steadily that we were convinced that we had made a mistake in diagnosis. Through June and July she again gained in weight but since she had gone past the supposed normal time for the birth of her young, no particular attention was paid to the increased weight.

At 10:00 a.m. July 22, 1941, a young porcupine five or six hours old was found with the female. The placenta was not shed promptly and within the next twenty-four hours two unsuccessful attempts were made to remove it. For several days the placenta was retained and the animal appeared ill, inactive, listless, took little food, ran a variable temperature and a thick grayish odorous discharge issued from the vagina. Her normal temperature had previously been

determined at 99° F. and because of continued treatments following parturition her temperature did not exceed 101.6° F. These treatments consisted of some medication, with frequent irrigation and cleansing of the vagina and uterus with warm soap suds, followed by a lysol douche. A metal restraining tube (Shadle and Ploss 1942) was used with great success in these treatments.

Improvement in temperature, appetite, and activity was extremely slow during the first weeks after parturition and on the fourteenth day a two-inch piece of umbilical cord about the diameter of a pencil was taken from the vagina. Sixteen days after parturition a 16.6 gram mass of placenta was discharged and preserved. On the twenty-fourth day following parturition, an additional 15.9 grams of placenta found protruding from the vagina were taken and preserved. Thereafter the grayish discharge from the vagina gradually subsided and the porcupine improved in health. Since placenta is usually shed in a few minutes to a few hours after parturition, the retention of all of the placenta for sixteen days and nearly half of it for twenty-four days was quite unusual.

The shed placenta showed some maceration but was not in as advanced a state of decomposition as might have been expected, but had a sour odor similar to sauerkraut.

The 12 lb. 3 oz. weight of this female four days before parturition dropped to 10 lb. 6 oz. after giving birth to a female, weighing 1 lb. 1 oz. Illness together with the drain of nursing her offspring further reduced the mother's weight to 8 lb. 12 oz. The young was separated from her mother at 52 days of age and thereafter the mother's weight steadily increased until she attained between twelve and thirteen pounds where the weight began to level off and subsequently the weekly fluctuations amounted to only a few ounces.

The breeding of this female occurred near the time of year that females usually give birth to young according to Struthers (*op. cit.*). He gives November and December as the usual time of mating and 16 weeks as the gestation period, which would bring the usual parturition period in early spring. Using these figures our female bred in late March or in April which seems much later than usual. Comparing the condition of the quills at birth in Struthers' animal with the quills of "Snookums", the young born here, suggests that the gestation period may be more than 16 weeks.

DEVELOPMENT OF YOUNG

When found five or six hours after birth, the young porcupine was completely covered with dense, long, black hair, thickly interspersed with hundreds of quills varying in length from a small fraction of an inch to spines an inch long. Many of the long quills were practically transparent toward the distal end and in the drying process they seemed to have collapsed until they were flat in this transparent area. The incisor teeth were well formed and in position but showed no signs of having been sharpened by abrasion of uppers upon the lowers and vice versa. The animal was walking about in an unsteady manner for the legs seemed neither strong enough nor the co-ordination of the muscles quite sufficient to provide steady locomotion.

The small dark beady eyes were wide open and they sensed moving objects nearby. "Snookums" resented being stroked or having the hair touched. When a hand was lowered to pick her up, she immediately made a perfect defense reaction by turning her head away and her rear toward the intruder and striking vigorously with her tail. One could feel the spines but the tail had insufficient force to do any damage. To an imitation of the porcupine whine she turned and walked directly alongside the human face from which the whine was coming.

Nursing was begun promptly and on the second day she readily accepted prepared Klim from a medicine dropper. Klim is dried whole milk, which needs only to be mixed with warm water and fed. The next day a small 15 cc test tube equipped with a rubber nipple from a doll's nursing bottle, made an excellent feeding bottle. Fifteen cc of the Klim was the amount she would take at one feeding. This extra food was given in case the illness and fever in the mother might reduce the normal secretion of milk. The extra feeding was discontinued after about ten days. "Snookums" continued to nurse for 52 days, which is long after porcupines are said to be weaned. By this time the mother had become so thin and the young so large 3 lb. 6 oz.) that the two animals were separated to allow the mother to regain her weight and a good physical condition before mating time. The mother immediately began to gain weight and by breeding time had nearly reached her normal weight. During the following weeks "Snookums" was allowed to get out of her own cage and she always went fairly promptly to her mother's cage. When she reached her mother, she immediately attempted to nurse to which the mother offered no objection. Until "Snookums" was three and a half months old she made these definite attempts to nurse, but it is not known how long she obtained milk.

The literature says practically nothing about play among porcupines. "Snookums" has shown a considerable playfulness. When playing with another animal of her size this play was a sort of wrestling match between the two. At other times "Snookums" plays alone by lying on her back like a kitten, rolling back and forth, clutching a pole or something with the fore and hind feet and often biting at whatever is clutched by the feet. At other times she runs about dodging, as if fleeing and trying to elude an enemy. The quills are usually erected, the head is often placed under some protection, the hind parts are thrust from side to side and the tail strikes viciously at the imaginary foe. She may also run about the cage or climb rapidly. In other words, the play resembles many of the reactions that go on in the daily life of the porcupine when fleeing and defending itself.

"Snookums" tamed quite readily and from early infancy has continually been picked up and carried around. Though she is handled quite frequently, she still prefers to go her own way without being petted, but she is friendly enough to come readily when she is hungry or when one goes in and begins to talk to her.

Among the early data and reactions recorded were the following:

Temperature when four days old was 98.1° F.
Average temperature to date, 247 days, is 99.6° F.
Began to chatter teeth on fifth day.

Scratching of head with hind feet began on 5th day but was not well executed until the 7th day.

Ate solid food, bread and poplar leaves, on the 9th day and took poplar bark on the 13th day.

Began to drink water on the 22nd day.

The food of this colony has been leaves and the bark of poplar and willow but they will eat very little fresh hemlock. Weeds, grass, carrots, cabbage, parsnips, turnips, potatoes, apples, raw rolled oats, wheat, dog chow checkers, and stale brean (rye, whole wheat and white) are all readily taken.

"Snookums" gained rapidly in weight and strength. The monthly weight range has been as follows:

Monthly Weight Range of a Young Porcupine

AGE	LBS.	OZ.	WEIGHT OF AVERAGE WILD PORCUPINE (STRUTHERS)
at birth	1	1	
1 month	2	12	
2 months	3	7	at end of first summer
3 "	5	5	
4 "	6	3	
5 "	8	3	
6 "	10	2	at end of second summer
7 "	11	7	
8 "	12	3	at end of third summer

Figure 1 compares the graphs of the weights of three porcupines, "Maudie" the mother, "Snookums" and "Pewee" a wild-born young one, probably a little older than "Snookums". When Pewee was brought into the laboratory in early September he weighed a little more than Snookums but Snookums soon surpassed him and has rapidly increased in weight. At two months, Snookums attained the weight given by Struthers (*op. cit.*) as the weight of the average wild porcupine

at the end of the first summer, her weight at five months equalled the average wild porcupine at the end of the second summer. At eight months her weight equalled the average weight of a wild porcupine at the end of the third summer, when practically mature. She weighed as much as her mother. Although they have been fed the same food, it will be noted that while Pewee has not gained as rapidly as Snookums, he has shown considerably more of a gain than that given for the average wild porcupine of his age. An attempt is being made to determine the factors responsible for these results.

The marked differences between the growth and weight figures obtained here and those obtained by Struthers, raises the question as to whether sexual maturity may not be attained at an earlier age than Struthers suggests. Further work is being done to determine this point.

SUMMARY

1. The second recorded case of *Erethizon d. dorsatum* bred and born in captivity occurred on July 22, 1941, at the Biology Department of The University of Buffalo. The time of this breeding and of the birth appears unusually late in the season.

2. Retention of the placenta occurred: 16.6 grams shed on the 16th day after parturition and 15.9 grams on the 24th day. Mother quite ill.

3. At birth, young weighed 1 lb. 1 oz., well covered with long black hair, spines very numerous, fraction of inch to full inch in length; eyes open, teeth well formed and in position; when only five or six hours old showed typical porcupine reactions to moving objects, to porcupine whine, and defensive reaction to an enemy. Nursed until 52 days old when taken from mother. Continued to attempt to nurse until she was 3½ months of age.

4. Early reactions. Showed considerable tendency to play, usually alone. On second day readily took extra feedings of Klim. Began on 5th day to chatter teeth, and to scratch head with hind feet. Began on 9th day to eat solid food, bread and leaves. Began on 13th day to eat poplar bark. Began on 22nd day to drink water.

5. List of food: bark, leaves, carrots, cabbage, turnips, potatoes, apples, rolled oats, wheat, bread, etc.

6. Remarkable growth in weight. At 8 months weighed as much as average wild porcupine at end of third summer (Struthers, *op. cit.*).

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AORTIC PARAGANGLIA (ZUCKERKANDL'S BODIES) IN THE GUINEA PIG

By Francis Marsh Baldwin, Ozro Brandt Wiswell and Wesley Gale Irons

Since the time when Zuckerkandl (1901) discovered and correctly described the occurrence of certain chromaffin bodies of small size lying retroperitoneally of the abdominal aorta in the human, little comparative work has appeared in the literature concerning either their position or their function in other mammals. In man, these bodies (paraganglia lumbalia) develop from sympathetic nodules and may fuse to form several large chromaffin bodies that lie at the level of the origin of the inferior mesenteric artery. These masses vary in size and number of coalesced bodies and are said to undergo partial

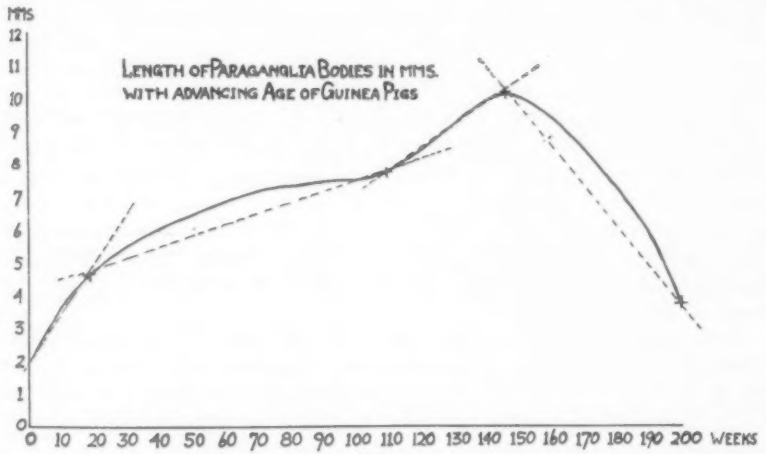

Fig. 1

retrogression after the state of puberty is reached. Gray (1936) and Cunningham (1922) agree substantially as to the origin, location, and appearance of these bodies, but call the largest masses of these coalesced nodules, formed on either side of the aorta, the aortic bodies, which brings some confusion into the literature since, strictly, this term refers also to bodies in the neck region of mammals (Schmidt, 1940).

While making autopsies on the guinea pig in connection with another problem it was noted by one of us (Irons) that these bodies undergo characteristic physical as well as morphological and probably physiological changes in respect to chronological age. Some of these observations form the basis of this report involving autopsies of 50 healthy animals, including both sexes, varying in ages from one week to almost four years. In all specimens the bilateral bodies were located retroperitoneally, invariably just 3–5 mm posterior to the aortic

bifurcation on the lateral margins of the common iliacs closely related to the ventral surface of the psoas muscles. In this position they were richly supplied with rami from the sympathetic nerve trunks. Small arteries from the common iliacs furnished blood, the venous drainage being by way of the psoas veins.

The aortic paraganglia of young animals of either sex were of a general length of 2–4 mm, depending on the age (1 to 15 weeks), the older animals having the larger aortic paraganglia. None was less than 2 mm in length, even in the week old animals. Thus, it may be said that these bodies undergo a period of rapid growth up to and including the 15th week. The color of the bodies during this time is a glistening white. In normal adult animals, the aortic paraganglia of both sex showed the same morphology but increased in size to 7–8 mm in length and became a glistening grey color. During the period from 15 to 105 weeks, the bodies tended to show a proportional decreased growth rate as indicated on the chart. It was found that in very old animals (105 to 200 weeks) the aortic paraganglia differed in their appearance, becoming greyish amber in color and increasing rapidly in length for a period of about 40 weeks, then sharply decreasing in length (in proportion to an increase in width) as compared with normal one year old animals.

It now becomes possible to segregate the entire chronological life span of the animals in general into four separate and rather distinct periods of aortic paraganglia growth as indicated in the accompanying graph; the first period of 15 weeks shows rapid development; a second period of about 90 weeks, of progressive decelerated growth; a third 40 week period of rapid proliferation, which goes into the fourth and last period of atrophy. During this last period the animals tend toward senility. The left aortic paraganglion is usually the larger of the two bodies.

In conclusion it seems evident from this data that: (1) The post partum anatomical characteristics of the chronological growth rate indicate that the size of the aortic paraganglia (Zuckerkandl's bodies) is relative to this rate; (2) in guinea pigs, the aortic paraganglia are in a definite location and have a definite blood and nerve supply; (3) the aortic paraganglia are present in these animals throughout their life span; (4) the morphological changes of the aortic paraganglia during the life span of these animals indicate that these bodies have some bearing upon the physiology of the animal.

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GENERAL NOTES

COTTONTAIL SUCKLING YOUNG

Seton (1929, Lives of Game Animals, Vol. 4) describes a cottontail in captivity suckling her young, but I can find no published account of a wild cottontail feeding the little ones at the nest. In view of this, it seems justifiable to record my observations of last spring.

On May 10, 1942, at about 5:30 p.m., a cottontail rabbit (*Sylvilagus floridanus*) was observed in a sitting position a few feet from a road bordering a small wooded area. At first it seemed that the rabbit was merely sitting in its form, but its reluctance to move from that spot as I advanced to within five or six feet indicated that some unusual condition existed. It was then easy to see that the rabbit's hind legs were spread wide apart, although the front legs were straight and the body was upright.

A few seconds later the cottontail scampered off into the woods exposing a nest and seven tiny rabbits. The young cottontails were all lying on the characteristic platform of excavated earth in front of the nest. Although their eyes were completely closed, they soon began to crawl into the nest cavity and a few minutes later all were nearly out of sight.

The next day their eyes began to open, and on the second day they were completely opened. The tarsal measurements on the second day averaged 34 millimeters. According to Beule and Studholme (Jour. Wildlife Management, vol. 6, no. 2), this measurement was taken when the young rabbits were eight days old, which would make them six days old when they were observed on the platform of the nest being suckled by their mother.

It is interesting to note that Seton tells of a captive cottontail suckling her young by curling herself around the outside of the nest and keeping the babies in the center. In this case, however, the little rabbits were all outside the nest and seemed to know their way back. It seems remarkable that such tiny things are suckled outside the nest before their eyes are opened.—Russell T. Norris, *Preston Laboratory, Box 847, Butler, Pennsylvania.*

FOOD OF THE SAN JOAQUIN KIT FOX

Recorded food items of the kit fox seem so rare that it was thought worthwhile to record the following: During a study of the San Joaquin Antelope Squirrel (*Citellus nelsoni*), 74 scats of the San Joaquin Kit Fox (*Vulpes macrotis mutica*) were collected to determine whether the kit fox preyed appreciably on the ground squirrel. The scats were picked up at the mouth of a den on July 21, 1941, about 6 miles east of Panoche, San Benito County, California at an elevation of 1200 feet. No squirrel remains were found in the scats even though the squirrels were abundant in the vicinity. Grass (*Bromus sp.*) was present in all 74. A species of particularly abundant grasshopper (*Oedaleonotus enigma*) was found in 66 scats. Other insects found were: *Pocalta ursinus* in 5 scats; *Coniontis sp.* in 1 scat, and *Stenopelmatus sp.* in 9 scats. *Dipodomus ingens* was found in 17 scats; *D. heermanni* was found in 10 scats; *Dipodomys sp.* was found in 14 scats; *Dipodomys* hair was found in 10 scats; unidentifiable rodent remains were found in 6 scats, and unidentifiable remains thought to be *Dipodomys* were found in 3 scats. Grinnell, Dixon, and Linsdale in "Fur-bearing Mammals of California" p. 416 report much the same type of fare except that the antelope squirrel is included. Dr. R. M. Bond kindly identified the items unknown to me.—Albert C. Hawbecker, *Madera, California.*

UNUSUAL FEEDING HABIT OF WOODCHUCK AND COTTONTAIL

During the late spring and summer of 1942, while a graduate assistant with the Pennsylvania Cooperative Wildlife Research Unit, the writer had the opportunity of observing through field glasses an unusual feeding habit of a woodchuck, *Marmota monax*, and of several cottontails, *Sylvilagus* sp. These animals repeatedly came to a stone porch of an unoccupied house and lapped the mortar between the stones, apparently seeking to satisfy their desire for some mineral (probably calcium). The porch floor was six inches above the ground.

The woodchuck was an adult female which had borne young during the spring. She was first observed on the porch late in May. Then she was not seen for several weeks. During the last part of June and all of July she appeared regularly. Although she was observed on the porch during all hours of the day, the woodchuck was most frequently seen in the early morning between 7:00 and 8:00 a.m. Eastern War Time. At first the woodchuck occasionally lapped on the stones also. She licked rapidly in one direction for a little while and then stopped. At the time, the writer believed that the woodchuck was lapping up ants, *Monomotium pharaonis* and *Cremastogaster* sp., (identification by Dr. S. W. Frost, Department of Zoology and Entomology, The Pennsylvania State College), which were fairly abundant on the porch. Later the woodchuck confined its licking almost entirely to the mortared cracks. Immediately after the woodchuck finished lapping, the floor was wet with saliva which had small air bubbles mixed in it.

Two young rabbits began coming to this porch in July. There was a large growth on the under side of the neck of one of the cottontails. This was probably caused by a botfly warble, *Cuterebra* sp. The parasitized rabbit was seen most frequently. Both of the rabbits confined their licking entirely to the mortar between the stones. The cottontails frequently played on the porch. They ran across it at great speed, hopped to the ground, and then hopped back up again repeatedly.

Both the cottontails and the woodchuck were wary when engaged in licking the mortar. A light stamping of the writer's foot at a distance caused the animals to scurry from the porch. They also stopped licking and became alert when there were any strange animal sounds in the vicinity. Once a young rabbit hastily left the porch when it was frightened by the raucous cry of a northern pileated woodpecker *Ceophloeus pileatus abieticola*.—Walter Robert Sylvester, *Forestry Department, State College, Pennsylvania.*

SOURCE OF FOOD FOR CHIPMUNKS

At 10:30 a.m. on September 20, 1942 at Point Abino in Welland County, Ontario, I saw a flock of 15 or 20 olive-backed thrushes (*Hylocichla ustulata*) feeding in the top of a 30 foot wild black cherry (*Prunus serotina*). By manipulating a fruit in its mouth, a bird stripped off the fleshy covering, and, eating that, let the stone fall to the ground. The thrushes were very active, constantly flying back and forth between the cherry tree and nearby butternuts and oaks with the result that the cherry stones were widely scattered on the ground. A Chipmunk (*Tamias striatus*) trapped about 40 yards from this tree had six fresh cherry stones in its cheek pouches. These thrushes had made available an appreciable source of food which would undoubtedly be used by many rodents scouring the forest floor during the next few days.—E. W. Jameson, Jr., *Department of Zoology, Cornell University, Ithaca, New York.*

ELEPHANT SEAL IN SOUTHEASTERN ALASKA

On page 19 of the 'Alaska Sportsman', vol. 6, no. 2, February, 1940, is a good photograph of an elephant seal (*Mirounga*) that was washed up dead on the beach at Kasaan, Prince of Wales Island, Alaska, shortly before the date of the above publication. It is stated to have measured over 14 feet in length, and estimated to have weighed between 3,000 and 4,000 pounds.

The above locality is, of course, far out of the known range of the elephant seal. The ocean current along this shore is northerly, so the animal may have drifted some distance after death, but the photograph shows it to be in good condition—just about as in life—, so it could hardly have been dead very long.—G. Willett, *Los Angeles Museum, Los Angeles, California.*

NOTES ON THE WESTERN RED FOX

On May 8, 1942, while on a field trip two miles west of Corvallis, Oregon, we found a den of the red fox (*Vulpes fulva cascadensis*). We were attracted to it by sharp barks given

at periodic intervals. The den was located about two-thirds the way up on the south side of a three hundred foot hill, in a strip of oak (*Quercus garryana*), which is characteristic of the lower foothills of the east slope of the Coast Range.

The entrance and exit, to the den were well concealed by dense growths of poison oak (*Rhus diversiloba*). Several well-worn and hard-packed trails lead in all directions from the entrance and exit.

Remains of captured prey found in the adjoining bushes and weeds revealed one whole left wing of a domestic turkey; parts of skin, tail, and feet of five gray diggers (*Citellus beecheyi douglasii*); and one forefoot of a jack rabbit (*Lepus californicus*).

Remains found within the den included (within one chamber) skin, tail, and bones of three gray diggers, and the foot of a chicken. In another chamber there was a wing feather of the Oregon towhee (*Pipilo maculatus oregonus*). In other chambers we found several feet of jack rabbits and a leg from a brush rabbit (*Sylvilagus bachmanni*).

The main entrance to the den was about 8 inches wide and 15 inches high. From the entrance, the tunnel tapered to a diameter of five inches, which diameter was constant throughout the remainder of the system. The excavated parts of the burrow totaled 47 feet in length.

In the den were four male and three female pups. They were estimated to be one and a half months old.

This locality is in the normal range of the gray fox (*Urocyon cinereoargenteus townsendii*). In the Coast Range, the red fox is usually found considerably farther west in the coniferous forests.—Robert Livezey, *Zoology Dept.*, and Fred Evenden, Jr., *Fish and Game Management Dept., Oregon State College, Corvallis, Oregon.*

NOTES ON TADARIDA MACROTIS IN UTAH

To date, there are three published records of the occurrence of this bat in Utah—Woodbury (Jour. Mamm., vol. 18, p. 515, 1937), Durrant and Behle (Jour. Mamm., vol. 19, p. 500, 1938), and Hardy (Jour. Mamm., vol. 22, p. 294, 1941).

To these records, we wish to add still another. This fourth specimen, an adult female, no. 3876, Museum of Zoology, University of Utah, was taken by H. W. Setzer, original no. 49, at Pine Valley, Desert Range Experiment Station of the United States Forest Service, Sec. 33, T. 25 S, R. 17 W, Salt Lake B. M., Millard County, Utah; July 3, 1941.

We feel this record worthy of note, due to the fact that it establishes an extension of range northward, approximately 110 miles into Millard County. All three of the previously mentioned occurrences are limited to Washington County, Utah, being from Zion National Park and St. George. It also establishes this bat as an inhabitant of extreme western and southwestern Utah. Furthermore, it indicates that it is not limited in this state to the lower Sonoran life zone, as this locality is in the upper Sonoran life zone.—Stephen D. Durrant and Henry W. Setzer, *Department of Zoology, University of Utah, Salt Lake City, Utah.*

A FOURTH RECORD OF THE COATI IN TEXAS

Taber (Jour. Mamm. vol. 21, pp. 11–14), in his discussion of the range of the coati in the United States, records three localities in Texas whence this animal has been seen or captured. He points out that the specimen observed at Eagle Pass was likely a captive brought in from Mexico.

In late February 1943, Archie Kelly, a resident of Con Can, Texas, encountered a large coati, which his three collie dogs had treed, on the Rio Frio, about 40 miles north of Uvalde, Uvalde County. When he appeared on the scene, the animal jumped out of the tree and was set upon by the dogs. The coati fought viciously, cutting them badly, and likely would have been the victor had not Mr. Kelly intervened. The animal proved to be an adult male measuring 56 inches in total length.

Mr. Kelly is of the opinion that at least one other coati ranges in that locality, which, if true, suggests that this typically Mexican species is definitely extending its range into

southern Texas and that it likely will become established.—W. B. DAVIS, *Department of Fish and Game, College Station, Texas.*

SEROLOGICAL EVIDENCE IN DETERMINING TAXONOMIC RELATIONSHIPS OF HIGHER ANIMALS

A few years ago it was found that animal relationships could be determined by a more precise method than that of homology (classification by physical structure). This new theory depended on the fact that blood is "a sort of quintessence of its chemical constituency."

It has been found that the blood of each species is chemically specific when compared with another species. That is, the blood of the dog is an entirely different chemical heterogeny than is that of the cat. Ordinary chemical analysis is unable to determine the difference in blood-composition between various animals, but that there are important differences has been understood for a long time.

Investigations along this line have been conducted by many serologists. They have found that if the normal serum of one animal were to be injected into an intermediary animal, certain immune factors were produced in the blood of the latter; and, if this antibody-containing blood were drawn from the animal, all solid elements removed, and mixed with the serum of the first animal in a test-tube, a heavy white precipitate occurred. Control tests, in addition showed that if immune serum were mixed with the serum of a closely related animal of the same genus a slightly weaker reaction occurred; if it were mixed with the serum of another animal still farther down the line, a comparatively still weaker action was produced. It is apparent, therefore, that the intensity of this reaction follows a curve of gradiency downward the farther from the focal animal the reaction is taken.

Distinct animal relationships can be brought to notice with little error. By using stronger solutions and increasing the time of reaction, distant relationships can be brought out. Nuttal and his collaborator Graham-Smith made thousands of such experiments upon problems of relationship and classification and it is of great importance that their highly interesting and significant work yielded results containing very few surprises and tended mostly to confirm the results of comparative anatomical and paleontological researches. Probably one of their most elucidating conclusions, the use of which might effectively be employed as an important criterion in the substantiation of present systems of mammalogical taxonomy, is the fact that "if sufficiently strong solutions be used and time enough allowed, a relationship between the bloods of all mammals is made evident."

It cannot be presumed that there exists any mathematical ratio between degrees of relationship indicated by the blood test and those that are shown by anatomical and paleontological evidence. The contrast between the blood of mammals and that of birds would immediately negate any such supposition. It could hardly be maintained that an ostrich and a parrot are more closely related than a wolf and a hyena, yet that is the inference from the blood tests. Like all other anatomical and physiological characters, the chemical composition of blood is subject to change in the course of evolution.

We have performed experiments confirmatory to those of Nuttal and Graham-Smith in noting, by direct laboratory method, the serological relationships between two species of the genera *Felis* and *Canis*. The procedure was as follows:

Selected as our comparatory animals from the aforementioned genera were the common house cat and an interbred Spaniel puppy. The selection of immature animals was prompted by the necessity of working with sera as free as possible from passive antibodies.

First we withdrew from the cat, by direct cardiac puncture, approximately 10 cc of blood, allowed it to coagulate normally, and then drained off the serum, which was then injected into a laboratory rabbit in increasing amounts for a two-weeks' period. After one week, the rabbit was bled and normal coagulation was allowed to take place.

Utilizing the dog serum as the antigen and the anticat serum as the antibody-reagent, we carried out the following precipitin test to determine optimal proportions of the two factors:

In separate test-tubes the antigen and antibody solutions were mixed with the following dilutions and proportions:

TUBE	0.5 CC ANTIGEN DILUTED	0.5 CC ANTIBODY DILUTED
1	1:10	1:10
2	1:10	1:20
3	1:100	1:10
4	1:1000	1:10
CONTROLS		
5	1:10	—— (saline 0.5 cc)
6	—— (saline 0.5 cc)	1:10

The results were as follows: Tube no. 1, heavy precipitate; tube no. 2, heavy precipitate of slightly greater intensity; tube no. 3, precipitate less intense than tube no. 2; tube no. 4, very weak reaction. In the control tubes no. 5 and no. 6 no reaction was noted. The comparative intensities of the above reactions were determined by both macro- and microscopic examinations. It will be noted that a greater precipitin reaction occurs in the tube wherein the antigen is of a greater concentration than the antibody.

The results indicate that the two animals are closely related serologically, a conclusion which substantiates the present homological positions of the members of the genera *Felis* and *Canis* within the order Carnivora.—MAX S. MILLAR AND OTIS ROY BURKET, *Fresno State College, Fresno, California.*

THE TYPE LOCALITY OF THOMOMYS BRIDGERI AND THOMOMYS OCIUS

The type locality of *Thomomys bridgeri* Merriam and *Thomomys ocius* Merriam, given by their authority (Merriam, Proc. Biol. Soc. Washington, vol. 14, pp. 113–114, 1901) as, simply, Fort Bridger, Wyoming, was defined more exactly by Bailey (N. Amer. Fauna, no. 39, pp. 107, 112, 1915), who collected the type series, as Harvey's Ranch, on Smiths Fork, 6 miles southwest of Fort Bridger.

On August 1, 1942, while in Fort Bridger, I had the pleasure of talking with W. H. Harvey who was host to the late Vernon Bailey while Bailey collected in the vicinity of Fort Bridger. Harvey, now 79 years old, remembered Bailey well and described him as a "mere lad" when Bailey first detrained at Carter Station, nine miles north of Fort Bridger. At Bailey's query as to where he might find room and lodging in the vicinity, Harvey offered his house and the run of his ranch. Bailey accepted and used the house as headquarters and the ranch as his principal collecting ground on that and a second visit several years later to the Fort Bridger area.

Harvey's ranch house, currently under other ownership, is now near the center of the town of Mountainview. Harvey, "in a weak moment" as he put it, converted one of his ranch buildings into a store. This was the beginning of the trading center which was to become Mountainview, a settlement now larger than Fort Bridger.

Bailey's collecting locality "Harvey's Ranch, on Smiths Fork, 6 miles southwest [*sic*] (see Hooper, Miscl. Publ. Mus. Zool. Univ. Mich., no. 52, pp. 25–26, 1942) of Fort Bridger, thus, may now be written as Mountainview, on Smiths Fork, four miles (airline) southeast of Fort Bridger, Uinta County, Wyoming.—EMMET T. HOOPER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

NUTRIA GOOD DIVER

On the morning of March 24, 1942, a nutria (South American Beaver—*Myocastor coypus?*) was timed while it remained quietly under water, in plain view of the writer, in Bitter Creek of Bitter Lake National Wildlife Refuge, Roswell, New Mexico. After 3 minutes

and 15 seconds, the animal came to the surface, watched the writer closely for a short time while regaining its breath, and then swam to the opposite bank only a few feet away, where it dried and sunned itself several minutes. It then proceeded to feed, apparently ignoring completely the intruder. Previous to the extended dive, the longest period of submergence had been 30 seconds while actively swimming: this was a shorter period than that observed for a female ruddy duck in Bitter Lake on February 12, when the ruddy remained under water 45 seconds while actively swimming. Whether the nutria was forced up for air, came up to get its bearings, or decided that it had eluded its observer after 30 seconds of submerged swimming, was not decided. The extended and inactive dive appeared to be one of its methods of trying to elude an observer.—CLARENCE A. SOOTER, *U. S. Fish and Wildlife Service, Frenchglen, Oregon.*

DURATION OF LIFE AND BEHAVIOR OF ALASKA FUR SEALS IN CAPTIVITY

A review of published records and personal correspondence showed that the survival of 29 fur seals, *Callorhinus ursinus cynocephalus* (Walbaum), in three aquaria averaged 2.6 years with a maximum of 9.2 years. The three aquaria were those of the U. S. Bureau of Fisheries at Washington, D. C., the Zoological Society at San Diego, and the California Academy of Sciences at San Francisco.

Observations were made on seven survivors of ten fur seals shipped December 10, 1941, From St. Paul Island, Alaska, to Seattle, Washington. The seals had been subjected to unexpected hardships in transit because of the outbreak of war. Four pups and three two-year-olds were kept at Woodland Park Zoo, Seattle, in a partly shaded, fenced enclosure containing a fresh-water pool of 4,000 gallons. Personnel of the zoo cared for and fed the seals. Feeding practices were decided by biologists of the U. S. Fish and Wildlife Service.

Food consumption varied greatly. Under the unnatural conditions of captivity the group averaged 2.2 pounds of food a seal a day for 261 seal-days. The last surviving individual fed heavily for a 47-day period during which its average daily consumption of fish was 5.73 pounds or 14 percent of its weighted average body weight.

For ready recognition the seals were marked by shearing small patches of fur from different parts of their bodies. Their activities were recorded. A male pup was twice seen to swim in a circle of twelve-foot diameter determined by the shape of the pool, for a distance of approximately 0.6 mile at 2.3 miles per hour, rising for air at each circuit. A two-year-old male swam much of the time for a two-week period shortly before its death, covering several miles a day at a rate which on one occasion was measured as 1.9 miles per hour for one hour. While floating during periods of relaxation this seal breathed at intervals of four or five seconds. Propulsion while swimming was solely by the front flippers. Bubbles were seen at different times to issue from fur, mouth, and anus of submerged animals. Rectal temperatures of two seals were 100.3 degrees and 100.15 degrees Fahrenheit, and of a third, a shivering pup, 98 degrees F. A pebble from the Pribilof Islands had remained in the stomach of one of the male pups for at least 57 days. A salt-lick and a tank of three percent salt solution sufficiently large for immersion of the seals were of little or no interest to them. Slightly more than a pound of water adhered to the fur of each seal after immersion and before shaking. The presence of crowds of people around the enclosure produced little effect upon the seals. Reactions of the seals to the presence of persons within the enclosure varied from a friendly, seeking attitude to a noisy belligerence.

The average duration of life for the seven seals while in the enclosure was 38.1 days with a maximum of 110 days. Causes of death could not be determined. Some of the seals accepted almost no food, while others apparently ate too much. Allowing too much to be taken at one feeding, and offering food seven instead of only six days a week were undesirable practices employed for want of better knowledge.—KELSHAW BONHAM, *U. S. Fish and Wildlife Service, Seattle, Washington.*

WEIGHT AND LENGTH OF WHITE-TAILED JACKRABBITS IN BLUE EARTH COUNTY, MINNESOTA

In his 1909 revision of the hares and rabbits of North America, E. W. Nelson noted that four adult *Lepus townsendii* Bachman from Madison, Minnesota, were the largest indi-

WEIGHT	LENGTH			
	Body	Tail	Hind foot	Ear
7.50	19.50	3.12	5.50	4.12
7.75	21.00	3.50	5.80	4.00
6.25	20.00	3.00	5.50	4.25
7.00	21.50	4.00	5.50	4.00
7.75	21.00	3.50	6.00	4.00
8.25	22.00	4.25	6.00	4.50
7.25	19.50	3.75	5.75	3.90
7.75	21.75	—	6.00	4.00
7.25	21.00	3.00	6.00	4.00
6.25	19.50	3.75	5.75	4.00
7.00	20.50	3.50	5.75	4.40
6.50	20.75	2.50	5.50	4.00
6.50	20.00	3.90	5.80	4.12
8.50	22.00	3.75	6.00	4.25
8.50	22.00	4.00	6.00	4.25
7.50	20.00	—	6.00	4.50
7.25	20.25	3.75	5.50	4.00
7.25	20.25	3.25	5.75	4.12
7.00	20.25	3.25	5.75	4.40
6.75	20.50	3.50	5.75	4.00
6.75	20.25	3.50	5.75	4.00
7.50	21.50	3.75	6.00	4.00
7.25	20.75	3.50	5.75	3.98
7.75	20.00	3.75	5.75	4.12
8.50	21.50	3.50	6.00	4.12
8.25	22.00	3.90	6.00	4.12
7.50	20.50	—	5.50	4.12
8.00	20.75	3.75	5.75	4.12
7.25	21.00	3.50	5.75	4.12
6.75	20.50	4.25	5.80	4.12
8.00	20.50	3.50	5.75	4.12
7.50	21.25	3.75	6.00	4.25
7.00	21.00	3.75	5.75	4.12
7.50	21.25	3.50	5.75	4.00
6.50	20.00	3.50	5.75	4.00
7.00	20.25	4.25	6.00	4.00
6.75	21.25	3.00	3.75	4.12
7.00	20.50	3.50	5.75	4.00
8.50	22.50	3.00	6.00	4.40
7.00	20.00	3.25	5.50	4.25
7.75	21.50	3.50	5.75	4.12
9.00	22.50	—	5.75	4.12
7.00	20.00	3.25	5.75	3.90
7.25	21.50	3.00	5.75	4.25
5.75	20.00	4.00	5.80	4.12
8.25	21.75	3.50	6.00	4.12
8.25	21.00	4.00	6.00	4.25
7.25	21.50	3.75	5.50	4.25
8.00	20.25	3.50	6.00	4.40
8.25	21.00	3.75	6.00	4.12
8.25	23.50	3.00	5.90	—
8.00	23.25	3.00	6.00	4.12
Average 7.4	21.0	3.6	5.8	4.1

viduals of the species examined by him. He remarked that, unless these individuals were chosen by the collector from a large number on account of their size, individuals of this species must reach their greatest size in this region.

Nelson did not specifically record the weights of these four individuals but stated that the average total length of five adults from somewhere in the range was 605 mm. Average measurements of tail vertebrae were 92 mm; of hind food 149; of dried ear, from notch to tip, 95.6 mm.

During December 1936, the writer had an opportunity to weigh and measure 104 individuals, that had been shot for the market at Rapidan, Blue Earth County, Minnesota, a locality about 120 miles southeast of Madison. Having been killed with shotguns, they had bled somewhat, and having been accumulated during a period of three weeks, beginning December 1, they must have lost some moisture, even though frozen immediately and kept so in an outdoor shed. Measurements of the body were made to the nearest quarter inch and weights to the nearest quarter pound.

The heaviest individual of the series weighed nine pounds. It was not the longest, its head and body, after having been thawed out for the purpose, measuring only 22.5 in. or 575 mm. The tail was missing. Had it been present but of only average length, it would have brought the total length to 665 mm or considerably above the 605 mm average recorded by Nelson. The longest individual of the series, also unfrozen, measured 23.50 in. or 695 mm from the tip of the nose to the tip of the tail. It weighed eight pounds.

The average individual of 50 that were measured had a 21 inch (545 mm) body; a 3.6 inch (90 mm) tail; a 4.1 inch (115 mm) ear (notch to tip); and a 5.8 inch (150 mm.) foot. The entire lot of 104 jackrabbits averaged 7.4 pounds.

Two individuals were decidedly pink in tone, as contrasted with the normal light brown.

Weights (in pounds) and measurements (in inches) of the unfrozen specimens are recorded in table on page 505.

It was possible to assemble such a large number of jackrabbits within a few weeks from the area almost surrounded by the Blue Earth and LeSueur rivers because of a considerable upward change in jackrabbit populations since the country was settled. One man who had settled near Rapidan in the 1880's exclaimed that it would have required "a hundred years" to accumulate a hundred jackrabbits at that time. Another said that forty years before one would have had to "comb the entire county" to collect so many. Even as late as 1930, flushing as many as three jackrabbits was remarkable in a day's hunt (see Jour. Mamm., vol. 17, pp. 112–114).

There was doubtless a gradual increase in numbers of jackrabbits as forests were cleared, thereby making more habitat available to them. Between 1914 and 1918, the rate of clearing of woodland and the degree of pasturing was greatly increased and, during the same period, many ponds and marshes were drained, thus making even more habitat available and probably improving that which already existed. However, the largest increase occurred during the middle 1930's and was probably due in large part to the drought of that period, which was so great that the U. S. Department of Agriculture in 1934 and 1936 placed that area in the emergency drought group of counties.

During October 1937, the day before the opening of the hunting season, the writer made a rough count of the number of jackrabbits that he was able to flush on a half section of land where, up to 1933, he had been able to flush only one, two or three on single trips. This area was, up to 1933, one of the best jackrabbit grounds in the half dozen sections surrounding the town and was a proven hunting ground for them. On this 1937 trip, the writer cruised the favorable half section in 40 yard-wide strips and flushed seven jackrabbits. Of the remaining territory that was not cruised it may be said that where in previous years hunting of jackrabbits had not been favorable, it now was very favorable.—CARL O. MOHR, *Illinois Natural History Survey, Urbana, Illinois.*

INCIDENCE OF DIPTERAN PARASITOSIS IN POPULATIONS OF SMALL MAMMALS

A heavy parasitosis of mice with larvae of the bot-fly (*Cuterebra*) came to our attention while trapping in Turkey Run State Park, Parke County, Indiana, August 26–30, 1941.

Because of the nature of the trapping, *Peromyscus leucopus* was the principal mammal taken. Of 108 specimens collected and examined, 28.7 percent (31 individuals) bore one or more larvae or had holes in the skin from which larvae had recently emerged. These figures include mice of all ages caught. One individual in juvenal pelage and not yet fully grown bore a single larva. Most of the larvae occurred in the inguinal region, the scrotal sac in the males being a common site, but occasional ones were found in the axilla or in the belly region. The incidence of occurrence in the two sexes of mice was about the same (males, 29.7 percent; females, 27.3 percent). Three was the largest number of larvae present on a single mouse; most of the parasitized individuals had one or two larvae.

Our catches of other mammals were much smaller. The single *Zapus hudsonius* collected had one *Cuterebra* larva in the inguinal region. A juvenile *Mus musculus*, 2 *Tamias striatus*, and 12 *Blarina brevicauda* showed no sign of the parasites, although they were taken in the same situations as infested *Peromyscus*.

Several larvae sent to Mr. Herbert T. Dalmat were identified by him as *Cuterebra angustifrons* Dalmat, a recently described species (Amer. Midl. Nat., vol. 27, pp. 418–421). The largest larvae found, apparently nearly ready for pupation, were 22 mm long and 10 mm in diameter. Even one larva of this size must be a considerable source of irritation and drain on the vitality of an animal as small as *Zapus* or *Peromyscus*. However, none of the infested mice, even those with three larvae, appeared emaciated. The two or three larvae present on a single mouse were usually in different stages of development; no mouse bore more than two mature maggots. Little permanent damage was apparent, even in those mice with a larva in the scrotum. In this latter condition the testis nearest the larva was usually pushed part way into the body cavity, but in one or two males this testis was smaller than that on the side opposite the larva. It is conceivable that either condition could produce abnormalities in spermatogenesis. In several mice, the hole left by emergence of a larva had begun to heal. Our catch of *Peromyscus* was as large as expected, indicating no severe decimation of the population, to date, by bots.

The time of year of these observations was that at which larvae of *Cuterebra* are known to be most commonly observed (Osborn, 1896, Insects affecting domestic animals, Bull. no. 5, new series, U. S. Division of Entomology). Larvae become mature in late summer and early fall, drop to the ground, and apparently spend the winter in the pupal stage. All the mice we collected were taken in moist, cool, wooded ravines. It is possible that these conditions were especially favorable for adult flies or for hatching of the eggs or development of the larvae. Unfortunately, time for trapping in dryer, upland habitats was not available. A stable of riding horses is maintained in the park within a mile of all areas trapped, but available literature indicates that this genus of bot does not occur on horses.

Examination of 2 *Peromyscus leucopus*, 7 *P. maniculatus*, 12 *Mus musculus*, and 9 *Microtus ochrogaster* collected in the first week of September in southern Indiana (Harrison and Jefferson counties) yielded no evidence of bot larvae. These mice were taken in fields in both moist and dry situations.

Other collectors have found *Cuterebra* in several species of small wild mammals. In their study of *Neotoma albigula*, Vorhies and Taylor (Univ. Arizona Agri. Exper. Sta., Tech. Bull. no. 86, 1940) found an incidence of 8 percent in 275 wood rats examined. They quote notes by D. A. Spencer recording a 62 percent infestation in 39 wood rats; the time of year is not stated. In a more recent paper (Jour. Mamm., vol. 23, pp. 94–95), Scott and Snead discuss heavy infestations of *Cuterebra* in *Peromyscus leucopus noveboracensis* in Iowa in 1939 and 1940. In 1939, a peak of 35.7 percent parasitosis was reached and in 1940 a peak of 29.9 (number of mice examined is not stated). September was the month of greatest infestation in both years, with smaller percentages in July, August, and October. These authors obtained some indications that *Cuterebra* was exerting an adverse effect on the population of *Peromyscus*. Burt (Univ. Mich. Mus. Zool., Misc. Publ., no. 45, pp. 41–42) found incidences of 0.0, 0.7, and 3.4 percent in *P. leucopus noveboracensis* in southern Michigan in 1935, 1936, and 1937, respectively. Dates of finding the larvae ranged from July 22 to October 5.

In studying small mammals in virgin hardwood forest in northern Michigan, Blair (Amer. Midl. Nat., vol. 25, p. 684; Jour. Mamm., vol. 23, pp. 33 and 35) made observations on *Cuterebra* parasitosis. Live-trapping between August 25 and September 22, 1940, disclosed the following incidences: *Peromyscus maniculatus gracilis*, 1.3 percent of 159 individuals; *Napaeozapus insignis frutectanus*, 23.1 percent of 52 individuals; *Tamias striatus lysteri*, 37.6 percent of 165 individuals. No *Cuterebra* were found in 28 *Blarina brevicauda talpoides* and in 9 *Clethrionomys g. gapperi*. This author suggests favorableness of forest conditions for *Cuterebra* on the basis of his finding larvae in the woodland mice *Peromyscus maniculatus gracilis* and *P. leucopus noveboracensis* as contrasted with the apparent lack of infestation in the grassland mouse *P. m. bairdii*.

Vorhies and Taylor's examination of about 200 kangaroo rats (*Dipodomys spectabilis* and *D. merriami*) in Arizona (U. S. Dept. Agri., Bull. 1091, 1922) disclosed no signs of *Cuterebra*. In jack rabbits, however, these authors found that infestations were common (Univ. Ariz. Agri. Exper. Sta., Tech. Bull. no. 49, 1933, pp. 549–550). Of the antelope jack rabbits (*Lepus a. alleni*) examined between 1928 and 1933, 31 percent were infested. In the Arizona jack rabbit (*Lepus californicus eremicus*) the incidence was 50 percent. In contrast to observations farther north, no periodicity in infestations was observed; large larvae were found at all times of year.

The records cited here indicate that various species of small mammals living side by side may differ greatly in incidence of bot fly parasitosis. Heavy infestations appear to be sporadic and local under certain conditions and more or less continuous under others. This difference may be causally related to the species of mammal, or to climate, or to the kind of *Cuterebra*. Specific causal factors and the effects on the mammals are still largely unknown, so carefully kept records of absence as well as presence of these parasites are highly desirable. Studies of their biology and taxonomy are being made by Herbert T. Dalmat of Cornell University.

We are grateful to the Indiana Academy of Science for a research grant which made this collecting possible, to the Division of Mammals, University of Michigan Museum of Zoology, for the use of collecting equipment, to the Indiana Department of Conservation for permission to collect in the state park, and to Herbert T. Dalmat and our colleague, Professor E. C. O'Roke, for identification of the parasites.—FREDERICK H. TEST AND AVERY R. TEST, *Department of Zoology, University of Michigan, Ann Arbor, Michigan.*

SUBSTITUTE NAME FOR *Geomys personatus minor* DAVIS

Through the courtesy of H. Harold Shamel, U. S. National Museum, I learned that *Geomys personatus minor* Davis (Bull. Texas Agric. Exp. Sta., No 590, p. 29, August, 1940) is antedated by *Geomys minor* Gidley, (Dept. Interior, Prof. Paper 131–E, p. 123, Dec. 26, 1922). As a substitute, I propose the name *Geomys personatus streckeri* Davis, in honor of the late Mr. J. K. Strecker, a well-known Texas naturalist.—W. B. DAVIS, *Department of Fish and Game, College Station, Texas.*

REVIEWS

Dice, Lee R. The Biotic Provinces of North America. University of Michigan Press, viii + 78. 1943. Price, $1.50.

In an attempt to map the major ecologic divisions of North America, Dr. Dice has come forward with a new "system," "based to a very large extent on the vegetation." According to the author, his major ecologic unit, the biotic province, differs from the biome (*sensu* Clements, which also is based upon the distribution of vegetation) in that the biotic province is a continuous area and not coincident with the climax. His divisions, in descending order, are: (1) biotic province, (2) biotic district, (3) life belt (vertical subdivisions of a biotic province), and (4) ecologic association (ecologically uniform and stable community below rank of life belt and biotic district).

A comparison of Dice's map with one by Carpenter (Ecol. Monogr., vol. 10, pp. 617–684, 1940) showing the extent of the grassland biome is of significance. Carpenter shows the short grass, mixed grass, and tall grass prairies and the prairie-forest ecotone as relatively narrow belts extending roughly in a north-south direction, differences in the type of vegetation resulting largely from differences in precipitation. Dice allocates the same area to parts of four different biotic provinces. By so doing he divides the short grass and mixed prairies into two provinces (Saskatchewan and Kansan), and places the tall grass prairie and the prairie-forest ecotone in two others, the Illinoian and the Texan.

This arrangement leaves the author open to the same criticism that has been advanced against Merriam's Life-zones, namely, the cutting across of natural ecologic areas. The prairie dog (*Cynomys l. ludovicianus*), for example, under Dice's system, must be assigned to at least three biotic provinces, as would a number of other species of prairie-dwelling mammals and birds. To the reviewer, such a scheme is no better than those that Dr. Dice proposes to replace.

Some justification for recognizing the numerous provinces outlined by Dr. Dice is found in the present distribution of the lesser systematic categories of mammals, subspecies, for example. But unless some system based upon species in determining the major divisions is devised, little value can accrue. If we must assign *Dipodomys merriami* to six biotic provinces, *Tamiasciurus hudsonicus* to five such provinces, *Thomomys talpoides* to nine provinces, have we made any headway?

A further commentary, perhaps of slight importance, seems warranted. Uniformity in the choice of names proposed for the areas is lacking. Some are named after Indian tribes, some after states, one after a country, one after a bay, one after a plant, and one is austroriparian!

As Dr. Dice frankly states, his classification of the major ecologic divisions is more or less exploratory. His contribution should stimulate considerable discussion and further investigation into a subject about which much has been written, but little is known.—W. B. Davis.

Storer, Tracy I. General Zoology. McGraw-Hill, xii + 798, illus. 1943. Price, $3.75.

Departing from the usual presentation of the subject, Dr. Storer has prepared a text book of zoology that should be well received by vertebrate zoologists. The student is introduced in part one to the field of general animal biology to acquaint him with the broader principles of animal life, and to prepare him for a critical study of the animal phyla. Subjects treated in this section include protoplasm, cells, tissues, organs and organ systems, reproduction and development, heredity and genetics, animal ecology, distribution of animals, organic evolution, history of zoology, and classification and nomenclature.

Part two is devoted to a study of the eighteen phyla recognized by the author, with pmphasis placed upon the Chordata, an emphasis probably resulting from the author's earticular interest in vertebrate zoology. To the Invertebrate Zoologist, this treatment of the subject will doubtless appear unwarranted. The Arthropoda, for example, which

includes nearly three-fourths of the known kinds of animals, many of which are highly important economically, is allotted 94 pages of text; the Chordata, including only one-twentieth of the Animal Kingdom, is allotted 211 pages. This feature may prove to be an obstacle to a wide acceptance of the book as a text.

Special features that add to the usefulness of the text are (1) synopses of classification, based upon external characters where possible, (2) special tables that facilitate the finding of usually scattered information, and (3) anatomical figures are new and so drawn that direct comparisons can easily be made.

The book is well printed, neatly and durably bound, and adequately illustrated.—W. B. Davis.

Kennedy, Bess. The Lady and the Lions. Whittlesey House. McGraw-Hill Book Co., Inc., New York-London. 221 pp., 17 pls. $2.50. 1942. Here is related a true story of a beautiful Texas town girl who became a United States government trapper. Mrs. Kennedy became interested in this field because it was her husband's career and she had often assisted him in riding his trap lines.

One of her special assignments was to trap mountain lions in the State of Texas where they had become a considerable liability to some of the stockmen. She relates the methods employed in scenting and setting her traps and the kind of traps and rifles used to take the mountain lions. On one occasion she bagged a strange and most unusual cat, an ocelot, which is a rare inhabitant north of the Rio Grande. Four of her lion specimens are deposited in the U. S. Biological Surveys mammal collection and have been identified as *Felis concolor azteca* and *Felis concolor stanleyana*.

This fascinating story reveals the tense moments experienced by a huntress finding her trap vanished from the set and sensing the presence of a hidden lion that had stepped into the concelaed trap and was now ready to pounce from a tree, spring upon her from somewhere, or suddenly finding herself staring into his fierce green eyes only some yards ahead of her in the brush. Mrs. Kennedy, who is a woman of small stature, possessed utmost composure during these tense moments. Her courage and technique used in puma control are deserving of the greatest admiration.—Viola S. Schantz.

Midlo, Charles, and Harold Cummins. Palmar and Plantar Dermatoglyphics in Primates. Amer. Anat. Mem. no. 20, 198 pp., 602 figs., 9 tables. $3.00. 1942. This latest addition to the Wistar Institute's well known series of anatomical memoirs is a monographic review of the comparative dermatoglyphics of the primates. Original observations on 36 genera of lemurs, monkeys, and apes are combined with a consideration of the literature (96 titles are listed in the bibliography) to produce a most useful encyclopedia of this phase of primate morphology. A total of 553 hands and 549 feet (exclusive of human materials), from all sources, forms the foundation of the study. The true worth of this type of study, regarded by many as a sort of "biological hack-work," can be appreciated only by one who has had occasion to bemoan its lack. Those of us who are working on non-primate groups may well envy the primatologists their growing list of really comprehensive comparative studies of anatomical details.

The bulk of the book is devoted to systematic recording, by means of special formulae, of configuration types and their frequencies. These shorthand descriptions are amplified by commentaries, notes, and graphs, where necessary. The addition of an extraordinary number of semi-diagrammatic illustrations completes the presentation of factual data.

The authors have undertaken a quantitative analysis of their unwieldy data by setting up a measure of configurational complexity or degree of pattern elaboration, which they call "pattern intensity." A scale of values, supposedly graded from most primitive to most specialized, is assigned to pattern details: arches, loops, whorls, and open fields. These values are then manipulated in various ways to express total intensity of palm or sole, comparative intensity of various fields and combinations of fields into which the palmar and plantar surfaces are divided, comparative intermembral intensity, asymmetries of

various sorts, etc. This is reminiscent of much of the work done by physical anthropologists, and while I admit that I may fail to understand the object of this kind of research, most of it impresses me as a rather aimless manipulation of facts and figures—doing all the interesting things that can be done with endless series of measurements or indices, without pausing to question why. I detect no important conclusions from the 36 pages of discussion and 13 tables and graphs that Midlo and Cummins have devoted to such analyses.

We learn (p. 168) that "one of the chief objectives of this study was to test the usefulness of dermatoglyphics as indicators of affinities among the primates." Twenty pages are given to discussion of this subject, again without significant conclusions. The old question (quite pointless except to physical anthropologists) as to which of the great apes is "closest" to man is given its usual consideration, with the usual result: "according to some dermatoglyphic criteria man resembles most closely *Pan*, in others *Gorilla*, and in still others, *Pongo*."

From first opening of the book, I felt that function should be a highly important factor in determining the arrangement of ridges on hands and feet. This question is referred to several times but usually from a negative standpoint, *e.g.* as a possible explanation for striking departures from the norm in one or more details in a given species. The authors' complaint that published observations on even the commonest species are inadequate for attempting to correlate use with volar pad modifications is unquestionably valid—I have often encountered similar difficulties myself—but a few afternoons of careful observation in a good zoo might have gone far to remedy this want. The correlation and convergence of structure in extreme cases, such as is found in the most persistent brachiators, *Ateles*, *Hylobates*, *Pongo*, is so obvious that it is highly unlikely that functional adaptation has not been an important if less obvious factor elsewhere.

A categorical list of conclusions and an index would have been useful additions.—D. Dwight Davis.

RECENT LITERATURE

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COMMENT AND NEWS

LETTER TO THE EDITOR

Sir:

Since the publication of my article on the Bottlenose Dolphin, in the August, 1942 issue, some people have verbally taken me to task for estimating the swimming speed of the animal as being less than 40, 50 or 60 miles an hour. Others however, thought the speed was lower. In the issue for May, 1943, Frank W. Lane has also indicated some disagreement with my estimates. It seems that some further discussion and clarification of my views are due.

The "popular magazine" to which I referred in my paper was LIFE. In an article on the porpoise it stated that the flesh was not palatable, which I found to be incorrect. It also stated that a porpoise could consume its own weight in fish in 48 hours. Since the stomachs of the animals weighed only about 40 pounds when full, while the animals themselves must have weighed 400 or 500 pounds and possibly more, that statement was considered to be completely wrong. Furthermore, since the estimated speed of 50 miles an hour was at variance with my observations, I was not much inclined to credit the article in LIFE as being critically done or authoritive.

My observations have been that Bottlenose Dolphins in four or five feet of water can be caught with an outboard motor boat having a speed of 22 miles an hour, although possibly they can move faster in deeper water. This has been verified by others who have hunted this dolphin. Furthermore, the only literature found on the speed of these animals, that of Townsend, which was quoted, was in agreement. Lastly, I am of the opinion that the speeds of animals is very often over-estimated by popular and scientific observers, unless adequate checks are made. The case of the South American fly which supposedly traveled at bullet speed has been clearly refuted by Dr. Langmuir. The speed of the snakes in this country has been shown to be very low and that of the famous Blue Runner, which many people say can overtake a fast running man or even a horse, has been shown to be at the most slightly in excess of 10 miles per hour. In my opinion the case of dolphins is similar and I am not willing to credit passing observations of mariners and some of my acquaintances on the high speeds of these animals. In short, this is an enlargement and explanation of the reasons for placing low estimates on the speed of the Bottlenose Dolphin. The open water, high seas species such as *Delphinis delphis* seem to be more streamlined and better made for swift swimming than *Tursiops truncatus*, which lives mostly in shallow waters.

Since my paper was published several more accounts of Bottlenose Dolphins fighting and killing sharks have been received.—GORDON GUNTER, *Rockport, Texas.*

A limited edition of Dr. Paul Errington's report "An analysis of mink predation upon muskrats in north-central United States" (Iowa Agr. Exp. Sta. Res. Bull. No. 320, pp. 797–924, 1943) has been released from the press. While the supply lasts, copies may be procured upon individual request to the Bulletin Office, Iowa State College, Ames, Iowa.

Dr. Emmet T. Hooper, Corresponding Secretary of the Society, has been commissioned Second Lieutenant in the Army Air Corps. He is now located at Randolph Field, Texas, carrying on physiological research. Dr. W. H. Burt and Philip M. Blossom (Museum of Zoology, University of Michigan) have taken over temporarily the responsibilities of Corresponding Secretary.

OBITUARY NOTICE

JAMES MOFFITT

1900–1943

James Moffitt, a member of the American Society of Mammalogists since 1929, was killed in a plane crash at Dutch Harbor, Alaska, on July 2, 1943, while on active duty with the United States Navy. Born in San Francisco on March 21, 1900, he was a descendant of one of the most distinguished pioneer families of California. His early education was completed in the San Francisco Bay region and abroad, while his college education, which was begun at the University of California at the age of seventeen, was terminated abruptly as a result of the entrance of the United States into the first World War and his consequent enlistment as a cadet in the Navy.

Upon his return to civilian life his interest immediately turned to ornithology. It was not long after this that he began making his own study collection of bird skins, principally from the Lake Tahoe region of California. Later he specialized in waterfowl and, at the time of his death, had one of the finest collections of geese in the Western United States.

In his earlier years he was employed with the paper firm of Blake, Moffitt and Towne. Later he joined the staff of the State of California Division of Fish and Game. In 1936 he was appointed Curator of the Department of Ornithology and Mammalogy at the California Academy of Sciences. Strongly imbued with a sense of patriotism and love for his country, he immediately offered his services to the Armed Forces after the bombing of Pearl Harbor and, in May, 1942, was commissioned a Lieutenant in the United States Naval Reserve. Very shortly thereafter he was assigned to active duty.

While primarily an ornithologist, in which field he was held in high repute, James Moffitt was also keenly interested in the natural history and conservation of mammals. This is attested to by the fact that eighteen of the seventy-eight papers of which he was author deal exclusively with mammalian problems.

In addition to the American Society of Mammalogists, he was affiliated with a large number of scientific and conservation organizations among which may be mentioned the American Ornithologist's Union, the British Ornithologist's Union, the National Audubon Society, the Wildlife Society, the Cooper Ornithological Club, the Wilson Ornithological Club, the Pacific Audubon Association, and the Grinnell Naturalists Club. Being active in conservation work and research, his death is a great loss to those persons and societies dedicated to the intelligent protection of birds and mammals as well as to his many friends and associates in the field of natural history, both in this country and abroad.—ROBERT T. ORR.

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NOV 23 1943

JOURNAL OF MAMMALOGY

VOL. 24 NOVEMBER 1943 NO. 4

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The Journal of Mammalogy

Subscription rates, $4.00 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

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Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the act of March 3, 1879

Made in United States of America

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